OCTOBER 1943

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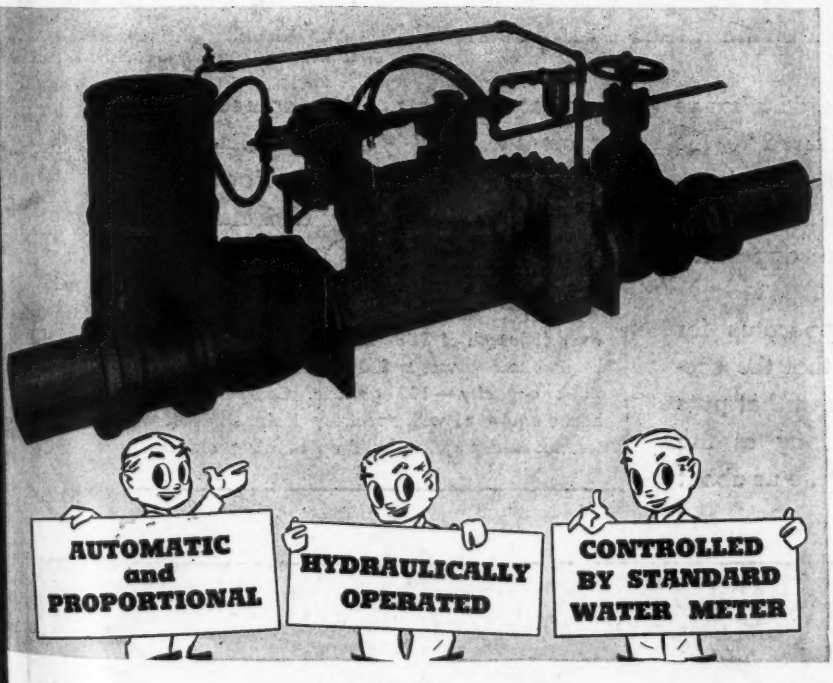
ENGINEERING
CONSTRUCTION
MAINTENANCE
OPERATION

Public Works

HIGH PRESSURE

Chem-O-Feeder



DESCRIPTION: Hydraulically operated utilizing water power from main to inject against line pressures up to 175 lbs. per square inch, feeds in strict proportion to variable flow through mechanical disc, turbine, propeller or other type meters using only 5 times amount reagent fed daily for operating purposes. Meter accuracy not affected. Only two connections to main, no balancing water pressure required for operation of this plunger pump. Later installations of additional feeders for other chemicals using same control meter easily handled. Chem-O-Feeders may be located out of meter pit at convenient working level with remote control piping.

USES: In addition to chlorination of variable flow water systems, Automatic & Proportional High Pressure Chem-O-Feeder is used to feed:

ACTIVATED ALUM	LIME SLURRY
ALUM	SODIUM ALUMINATE
BLACK ALUM	CAUSTIC
SODA ASH	FERRIC CHLORIDE
FERROUS SULPHATE	SULPHURIC ACID
FERRIC SULPHATE	AQUA AMMONIA
CALGON	ALUMINUM SULPHATE, ETC.

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for Pittsburgh

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● Two of these Ward LaFrance triples* have just been delivered to the City of Pittsburgh. From bumper to bumper, they are engineered to *Pittsburgh's* needs by past masters of fire apparatus engineering.

When you purchase fire apparatus for your community, remember that the economical "buy" is the equipment that puts maximum fire-fighting efficiency at the disposal of the department. Write us about your requirements. Our engineering department will gladly make detailed recommendations to fit your particular situation with maximum economy and efficiency.

* These Triple Combustion Pumpers have an overall length of 24'5" and a 185" wheel base. Engine horsepower is 200 at 2100 R.P.M. Booster Tank capacity — 100 gallons. Completely air brake equipped with specially designed devices for necessary quick build-up of air pressures.

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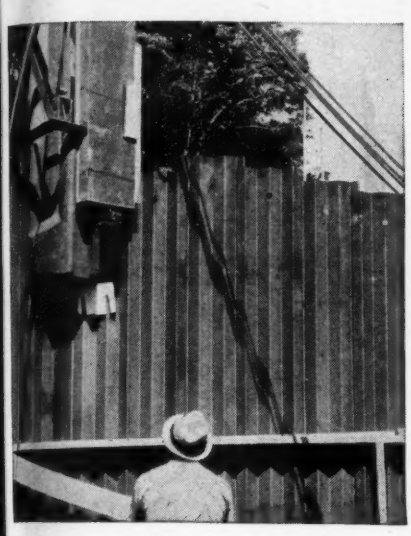

Steel is too precious to be wasted, even on vital war projects. When metal sheeting *must* be used, ARMCO can show you how to do the job and not waste steel.

Lightweight ARMCO Sheeting carries no excess metal. Lengthwise corrugations provide a stiff backbone—help it to stand up straight without flinching under driving blows. Fewer sections are needed to do the work because this sheeting can readily be pulled and used over and over again.

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Order ARMCO Steel Sheeting in the exact gage and width you need. It is supplied in the following types: Flange (12 in. width, 12 to 3 gage, max. length 18 ft.), Clip (12 in. width, 12 to 10 gage, max. length 16 ft.), Interlocking (14 in. width, 12 to 7 gage, max. length 18 ft.). Armco Drainage Products Assn., 325 Curtis Street, Middletown, Ohio.

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PUBLIC WORKS

Founded in 1896

Devoted to the interests of the engineers and technical officials of cities, counties and states

Vol. 74 No. 10

A. PRESCOTT FOLWELL, Editor

Price of this issue $1.00

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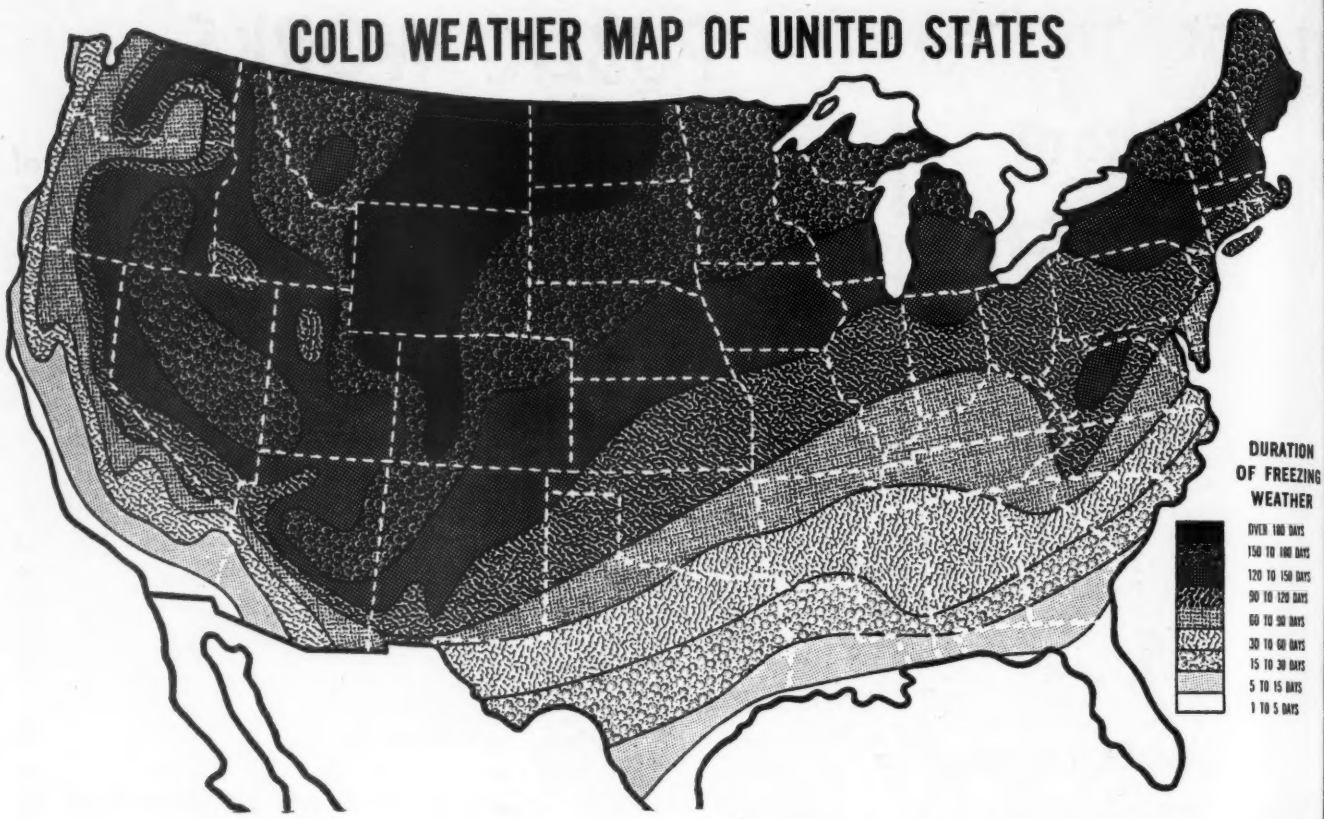
COLD WEATHER MAP OF UNITED STATES
DURATION OF FREEZING WEATHER
OVER 180 DAYS
150 TO 180 DAYS
120 TO 150 DAYS
90 TO 120 DAYS
60 TO 90 DAYS
30 TO 60 DAYS
15 TO 30 DAYS
5 TO 15 DAYS
1 TO 5 DAYS

Prepare for Ice Control Before Winter Comes

Jack Frost moves in on us EVERY year whether he is wanted or not and stays as long as six months in some sections of the country, as the above map shows.

Before winter, squirrels store away their food, householders their fuel and farmers their fodder AND foresighted officials do their fall stockpiling for ice control.

Highway departments that prepare stockpiles of abrasives treated with calcium chloride BEFORE WINTER ARRIVES save a lot of grief and expense.

Experience and tests show that 1 load of calcium chloride treated abrasives gives skidproofing effect equal to 3 loads of untreated grits. This means, therefore, that only one-third of the number of trucks and men are needed to do the same job.

Do it the EASY way before the freezeup instead of the HARD way in a blizzard. The EASY way is the ECONOMICAL way.

Abrasives treated with calcium chloride:

(1) Stay unfrozen. Stockpiles open up easily for handling.

(2) Load fast and spread evenly.

(3) Bite into ice, give traction immediately and stay anchored.

Ask for a free copy of Bulletin 27, detailing recommended practice for better, faster, easier ice control. Calcium Chloride Association, 4145 Penobscot Bldg., Detroit 26, Michigan.

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FAST • POSITIVE • ECONOMICAL

MAKES ICY ROADS SAFER

SAVES UP TO $6.00 A MILE EACH TREATMENT

When you need special information—consult the classified **READER'S SERVICE DEPT.**, *pages 69-73*

THE WAR EMERGENCY

Priorities as Applied to Sewage Works Construction, Maintenance and Operation

W. H. Wisely, Secretary of the Federation of Sewage Works Associations, has sent to the members up-to-date material relative to priorities as applied to sewage works construction, maintenance and operation, consisting of regulations and instructions issued by the War Production Board. This service was made possible by the cooperation of Maury Maverick, Director of the Government Requirements Division, Henry M. Evans, Chief of the Sewage and Sanitation Section, and A. M. Rawn, Consultant to the Board. Sewerage officials who do not have copies of these publications can obtain them by applying to the Board.

The publications are as follows: General Preference Rating Order P-141, as amended July 5, 1943.

Preliminary Application for Construction, Form 2814, dated July 15, 1943.

Outline of information to accompany Form 2814.

Regulations governing storm sewer maintenance, CMP Reg. 5A, as amended June 4, 1943.

General priorities regulation, PR 3, as amended August 10, 1943.

Instructions concerning all procedures relative to Sewerage and Refuse Disposal. Pamphlet No. 2.

The last named will be welcomed by the many who find it difficult to understand what the various orders issued by WPB require them to do. It describes in plain language and few words how to make application for priority assistance for construction of new plants or additions, for purchase of capital equipment where no construction is involved, how to obtain preference rating for maintenance, repair and operation of sewers and sewage pumping and treatment works, for refuse and garbage collection and disposal. In general, says this pamphlet, "Agencies engaged in supplying public sewerage services should secure a copy of preference rating Order P-141, July 5, 1943; those engaged in refuse collection and disposal and in the operation and maintenance of storm sewers should secure CMP-5A (June 4, 1943) and PR-3 (July 16, 1943); those who desire to purchase equipment where no construction is involved should secure and make application on Form WPB-541 (formerly PD-1A), and those who desire to build sewers, sewage and storm water pumping stations, sewage treatment plants and refuse incinerators should secure Form WPB-617 (formerly PD-200) and Forms 2814 and 2814.3. All of these may be secured from the Regional or District WPB office or from WPB, Washington, D. C.

The Ban on Bituminous Paving Materials Lifted

There has been a decrease in military demands for asphalt and tar products due to the completion of the major paving projects, and on Sept. 11th the ban on paving uses of these materials, which was issued a year ago, was lifted. However, the delivery or acceptance of road oil for paving or dust palliative purposes on roads or any other surfaces is still prohibited because of the use of this product for making heating oil.

Federal Government Needs Draftsmen for War Work

Over a hundred draftsmen of all types, particularly ship, electrical, mechanical and topographic, are needed by the several bureaus of the Navy Dept., Coast and Geodetic Survey, and the Geological Survey. Entrance salaries range from $1752 to $3163. Qualified enginering draftsmen in any field are urged to apply, except such as are "now using their highest skills in war work." Application forms can be obtained from first- and second-class post offices or Civil Service offices.

Use of High School Students on Municipal Work

With the increasing scarcity of men for all kinds of employment, several cities are using high school students out of school hours. In Springfield, Ill., students are being employed on street repair and maintenance work; already all the common labor on several miles of patching and resurfacing has been done by about 40 boys. In Upper Darby, Pa., high school students, receiving 70 cents an hour for work after school and all day Saturday and Sunday, are assisting in collecting garbage.

State Agencies for Postwar Planning

The states of Ohio and Texas have recently created postwar planning commissions. The new Ohio agency of 21 members will cooperate with local governments in the preparation of plans for postwar public works. The Texas agency is charged with making a study of postwar economic problems and with cooperating with other groups including local units.

The city of Newark, New Jersey, has adopted an ordinance creating a planning board of nine members which is to serve as a clearinghouse for all governmental plans and projects and will undertake postwar municipal planning.

Postwar Reserve Funds

Nineteen states have enacted legislation authorizing municipalities to establish capital reserve funds for future public works construction, three of them—Florida, Maine and New Hampshire—within the past few months. The other 16 states are Arizona, California, Connecticut, Kentucky, Massachusetts, Michigan, Minnesota, Nebraska, New Jersey, New York, North Carolina, North Dakota, Oregon, Pennsylvania, Rhode Island, and Washington.

These funds will enable cities to begin carrying out postwar plans immediately when the employment situation makes it desirable.

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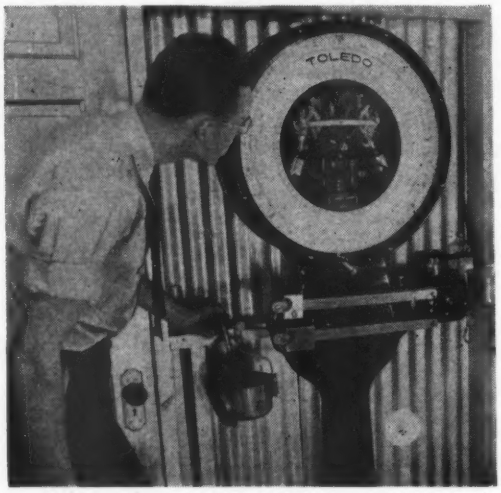
Every batch as specified, within close working tolerances

[SC]² CONTROL definitely improves concrete quality and reduces its cost. It saves the cement that has to be added to provide for expected variation in the W/C Ratio, most of which is unavoidable under ordinary batching methods; also provides accurate yield and saves truck time, and stock piling for moisture control. Guarantees delivery of the correct quantities of all ingredients, including cement, by making a graphic record of all weighing operations. It includes the following features:



The [SC]² Moisture Meter. The only unit capable of determining moisture content in less than 1 minute.

MOISTURE DETERMINATIONS, accurate to ¼% made in one minute; one for every batch when necessary.

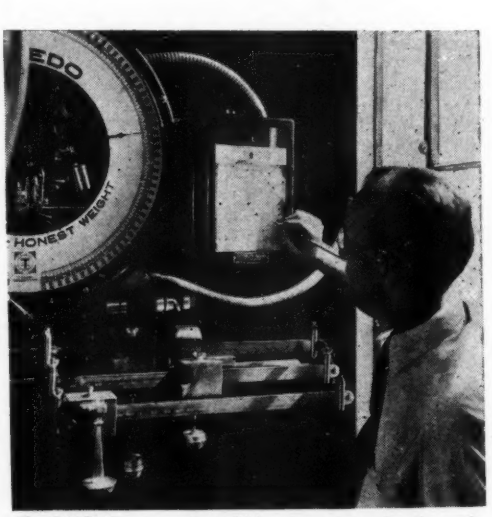
AUTOMATIC COMPENSATION FOR MOISTURE CONTENT in fine and coarse aggregates. Does not require calculations, charts or tables. With it, any intelligent weighman can produce remarkable uniformity.

PRECISION PROPORTIONING OF ALL INGREDIENTS using TOLEDO, the world's most accurate scales. Automatic cut-off is used for cement and water and is optional for aggregates.

AUTOMATIC GRAPHIC RECORDS OF EVERY BATCH showing the delivered weight of each ingredient and the exact time of batching. When combined with time stamp on batch tickets this provides positive batch identification on the record.

[SC]² CONTROL saves money and produces uniform concrete on job installations, in ready-mix plants and in dry-batching operations. Used on a number of the most important war projects including the PENTAGON BUILDING, Washington, and the DODGE BROTHERS CHICAGO PLANT.

For information on what **[SC]²** control is doing for others, references for direct investigation, or an estimate of what it can do for your plant, without obligation, write today.



The [SC]² Compensator which compensates for the moisture content in every ingredient and graphically records its every operation.

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[SC]² IS TO CONCRETE AS STERLING IS TO SILVER.

PUBLIC WORKS Magazine . . . October, 1943

Vol. 74. No. 10

Trenching and Laying Sewer and Water Pipe

This is one of a series of articles being published in PUBLIC WORKS to provide a text book for the superintendent, operator or engineer in charge of water or sewerage plant operation, construction and maintenance. Previous articles have included: Operation of Sewage Treatment Plants; Operation of Water Treatment Plants; Water and Sewage Chemistry and Chemicals; Hydraulics Simplified. The next article in this series will be published in the spring of 1944.

I. Introductory and General

1. Purpose and Scope.—There are correct and incorrect, and also safe and unsafe, methods of trenching and laying pipes. Care, proper planning, forethought and the consistent use of methods shown by experience to be proper yield big dividends. Items to be considered are: *Organization* and *planning; location* of the pipe line so as to minimize loss of time in looking or digging for it in case of need, and to prevent possible damage to it from other construction; *safe methods* in construction in order to avoid loss and injuries due to accidents while the work is in progress; *accident prevention* by adequate protection of openings, thereby safeguarding traffic; *proper bedding* of the pipe and correct methods of backfill in order to minimize breakage and subsequent frequent repair; approved *pipe laying and jointing* methods; *handling* the pipe, *cleaning* and *testing* the pipe and the completed line; *sterilizing* water mains; *placement* of hydrants, valves and manholes; *procedures* in force account and contract work; and many other important, though minor, phases of the work. It is the purpose of this article to discuss these factors from a practical viewpoint.

2. Preliminary.—Before starting to lay a pipe line, whether water or sewer, it is necessary to plan the work and to organize it so as to carry it out speedily and economically. Most municipal pipe lines are laid in or along streets or highways. Delays in construction should be avoided, with the aim to minimize interference with proper use of roads and streets, to reduce the financial losses that merchants suffer when the streets on which they are located are partially or wholly obstructed, and because it is desirable and usually economical to carry on construction vigorously and thereby make the needed facility promptly available.

Construction may be carried on by contract; by the workmen already in municipal employ and ordinarily used for such work; or by force account, utilizing departmental foremen or supervisors but hiring a considerable number of additional workmen. The selection of the methods to be used depends very largely on local conditions; each has its proper place.

3. Contract Work.—The small community faced with the problem of constructing a project of considerable size will almost always find it advantageous to carry on the work by contract, since the community lacks the organization, the skilled workmen and the special equipment needed for construction. Moreover, the cost of the work is known closely in advance, as the contractor is required to bid on the work. Some additional allowance should be made for "extras" and for special work which could not be foreseen in advance, but as a rule, in well engineered jobs, these will be small.

When work is to be done by contract, an engineer should (a) prepare detailed plans so that all of the contractors who bid on the work will know exactly the nature and amount of the work they will be required to do; (b) prepare detailed specifications that will state clearly what materials are to be used, what equipment is to be furnished, and the general methods by which the work will be done, where this is essential to proper construction; and (c) make an estimate of the quantities of the various items of work to be done and of their cost. Where approval of the State Board of Health is required, as is practically always the case with sewers and usually with water mains, the engineer should arrange for this approval. Copies of the plans and specifications should be available to all who wish to bid. It is customary to make a charge for each copy of the plans and specifications, but to refund the money charged if they are returned within a stated time.

(Continued on page 24)

Soil-Cement Runwa Du

By INNIS W. WARD
City Engineer, Duluth, Minn.

Innis Ward

Earl Olsen, Airport manager in charge of field.

THE Duluth Municipal Airport, known as the Williamson-Johnson field, comprises an area of 1,000 acres. The master plan provided for three runways, each 5,000 ft. long, together with connecting taxiways and 13,800 sq. yds. of concrete apron at the hangar building. The planned width of each runway surface is 150 ft., and an additional landing strip of 175 ft. on each side of the runway gives a total width of 500 ft.

A training program for pilots was carried on during surfacing operations, and it was necessary to use a temporary field in connection with the partially completed runways, the training of 500 pilots and the construction program being co-ordinated under the Airport Manager, Earl Olson.

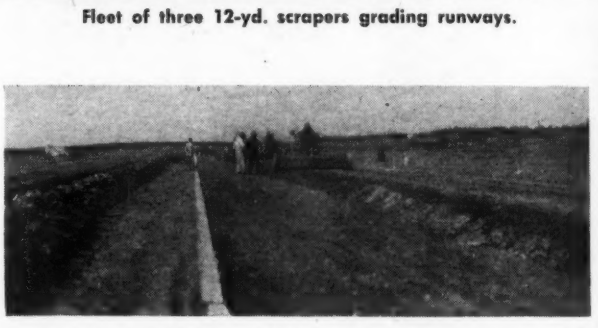
The grading of the three runways was completed during 1941 and plans and estimates were prepared by the City Engineering Department for various types of surfacing. This department recommended concrete paving for the runways as the most desirable, durable, and economical because of the low cost of maintenance; but as completion of the airport was dependent upon Federal aid through WPA and the government refused to finance surfacing costs as expensive as concrete, the city decided to construct soil-cement with a bituminous wearing surface.

Drainage structures had been practically completed before processing was started. The drainage system consisted of French drains of perforated metal pipe placed 3 ft. outside the runway line and on each side of every runway throughout its length. Experience has shown that adequate drainage is of primary importance in the surfacing of runways regardless of type of pavement, and results here support such experience as being sound.

Inspection of the airport area was made to locate soils available and practicable for use in soil-cement; following which, certain areas were further explored by visual inspection, test pitting and sampling. Then tests were made by the three methods approved by the A.S.T.M. known as moisture-density, wetting and drying, and freezing and thawing. Data from these tests formed the basis for selection of the area and also for developing the formula for percentage of cement to be used. The percentage of cement actually used was ten per cent by volume of the minus 4 of the material. It was found that use of the natural soils in the runways would not be economical as it would have required too high a cement content; therefore the material was trucked onto the runways from tested areas of the airport site.

Walter H. Flood and Co., chemical engineers and paving technologists of Chicago, were engaged to make the original soils analyses and to run the wet-dry, freeze-thaw and moisture-density tests, which require laboratory equipment that is found in only the larger laboratories. The field laboratory was in charge of John Fredin, assistant construction engineer of the city and now captain in the U. S. Army.

Fleet of three 12-yd. scrapers grading runways.



Rotary-tiller at work. Note 6 x 6-in. form down center of picture.

As a base for the soil-cement surfacing, a bank-run gravel was distributed over the full width of the runways to a depth of 6 inches above the subgrade and very thoroughly compacted with a sheeps-foot roller.

Then sufficient processing material for the surface was trucked in and dumped to make a layer 6 inches thick after rolling, with a slight excess. Forms of 6 x 6 in. timbers were set in 30 ft. lanes. Work was started by scarifying 5½ in. deep. Each day rows of paper sacks of cement were spotted throughout the length of the 30 ft. lane that would be covered by that day's work, and were broken open and the cement spread in transverse windrows. The cement was further spread by a drag harrow, and was dry mixed with the soil, using spring tooth cultivators, disc cultivators and gang plows.

As soon as the cement had been tied into the soil, the gang plow was used to turn up bottom material and speed up mixing, the depth of plowing being regulated to cut to subgrade, this being checked and controlled by string line measurements off the forms. The gang plow started near the center of the lane, turning the mixture toward the center and working out to the edges. When the edge strip had been completed, the

Duluth Municipal Airport

Laboratory analyses of available soils used as a basis for selection of those used. Bank-run gravel used as a base. Details of method of distributing, mixing, and rolling. List of equipment used.

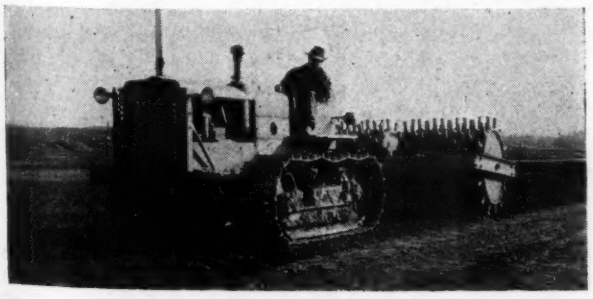
final clean-up along the forms was performed by hand using square shovels. This method insured thorough mixing along the edge when the mixed material was returned against the form. The mixing tools continued in operation as much as possible during the plowing.

As dry-mixing proceeded, representative samples were taken from the mix to determine moisture content, which was used as the basis for estimating the quantity of water required to bring the mixture up to optimum. Water was spread by tank and pressure distributor uniformly over the section until about 90 to 95 per cent of the required amount had been applied, the mixing tools continuing active to insure thorough moist mixing. As the moisture content approached the optimum, the lane was again plowed and cultivators continued to follow the plowing to develop the most thorough mix.

Moisture check-tests and field moisture density tests at this stage determined the remaining amount of water to be added to give the optimum for the material being processed and the density to be obtained by compaction. During weather of high wind and consequent high evaporation, pre-wetting the material that was to be processed was used quite advantageously, as this saved processing time and kept the water-spreading equipment busy when it would otherwise have been idle.

When the material had been thoroughly mixed, the sheeps-foot rollers were started, compacting the mixture from the bottom, and continued operating until the roller "walked out" within 2 inches of the loosened surface. During weather of high evaporation, light water applications were made to the damp mix in order to maintain proper moisture at the finishing surface.

The spike-tooth harrow was next used to scratch out surface compaction planes left by sheeps-foot rollers; following which the auto patrol was used, making a light cut with the blade to shape the finished surface to proper grade. Grade checks by string line were



Final operation of sheeps-foot roller. Note that roller has "walked out" and is riding on ends of "feet."

Airview of field during processing operation.

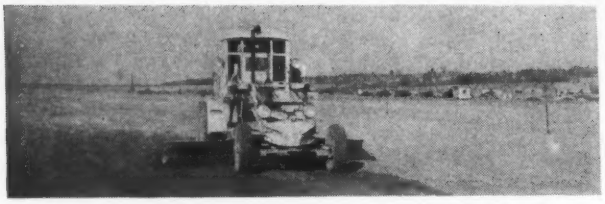
made during this operation to insure a uniform final section. To develop proper crown and alignment, it was sometimes necessary to shave down high spots and crowd the resulting light windrow into areas showing depressions.

The tandem 10-ton steel roller then rolled the surface and completed the compaction, light water applications again being made during weather of high evaporation. The pneumatic rollers performed the final operation of developing a tightly knit, smooth surface.

The completed section was immediately covered with Sisalkraft paper and either small quantities of soil or small boulders were placed on the edges of the paper to insure its not blowing off. The cover was left on for seven days to permit proper cement hydration and hardening.

Soil-cement inspection was provided at the job site continuously. The inspection covered grading, subgrade conditions, form setting, preparation of material for processing and control of all processing operations, particularly the application of water to the mix.

A frame laboratory building 6 x 8 ft. built on skids was spotted each day at the location most convenient for that day's work. The laboratory was well equipped with scales, balances, Procter mold machine, two-burner stove, dry-sample-field-density-determination apparatus, fry pans and glass graduates. The size of the laboratory was kept small in order to discourage loitering in the lab by visitors or employees not actually lab men, there being room for only the two lab men and apparatus when running tests. It was necessary to protect the time of lab men, who must rapidly run tests for prompt and accurate control of each day's processing as it approached the final operation of that day's work.



Final shaping by auto patrol, before rolling.

The total area processed for the three runways and taxiways was 195,292 square yards.

The equipment used in this work was as follows:

2—Fordson rubber tired tractors; 1—Seaman motorized pulvi-mixer; 1—Seaman heavy-duty material mixer; 2—3-bottom John Deere gang plows; 1—Rosco pressure water distributor. 4—1,000 gal. water supply tank trucks, 2—Double drum sheeps-foot rollers; 1—10 ft. spike-tooth harrow; 1—Pneumatic tire roller; 1—10-ton Galion tandem steel roller; 1—Adams Diesel auto patrol; 1—4 x 8 ft. steel roller, bristle-broom drag; 1—4 x 8 ft. nail drag; 6,000 l. f. of 6 x 6 in. timber forms; 10,000 sq. yds. of Sisalkraft paper; 5—5 kw. gasoline and Diesel light plants.

The field laboratory equipment comprised: 1—Rocker screen 16 x 16 in., ¼ mesh; 1—Chicago Scale Co. platform scale; 1—Tension Balance Co. scale; 1—Procter mold machine complete; 1—Nest of testing screens; 1—Electric plate for drying samples; Miscellaneous beakers, scoops, chisels, trowels, etc.

In June, 1943, the city was notified that the Civil Aeronautics Authority had allocated to this project $400,000 for further grading, draining, top-soiling and seeding, and to lengthen the landing strips and pave runways. Completion of the project probably will require an additional appropriation later on.

Sewer Rentals Outside City Limits

Lexington, Kentucky (49,304), receives $6,500 per year from sewer rental charges levied on the owner or occupant of each building outside the city limits which uses the city's sanitary sewer system. Fees charged range from $4.80 per year for a three-room residence to $9 per year for a 10-room residence, and for each apartment in apartment buildings $4.20 per year. The city does not collect sewer rental fees from property owners inside the city limits. The plan, which has been in effect for eight years, has proved very satisfactory, according to City Manager William White.

Low Rates for Municipal Bonds

Never before have cities been able to borrow money so advantageously. According to the "Bond Buyer," the average bond yields of 20 large cities in August, 1943, was 1.83%. Previous to July, 1943, the all-time low was 1.90%, in November, 1941.

Postwar Planning in Lewiston, Idaho

In his annual report for the year ending June 30, 1943, the city engineer of Lewiston, Idaho, under the heading "Postwar Projects," referring to a street improvement project, says: "This project calls for drainage, grading and paving estimated at $3,230.43. Surveys and plans are completed and the project is being held in abeyance for the duration of the war." Also plans are already made for a greatly needed swimming pool estimated to cost $25,000. The Junior Chamber of Commerce has raised $7,874.32 and a citizen left $7,875.68 in his will, all of which has been invested in Series F Government Bonds.

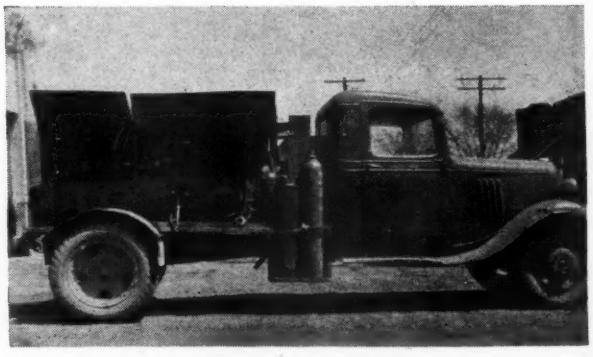
Carlton County's Electric Welder

By N. C. NICKERSON
County Highway Engineer, Carlton Co., Minnesota

Motor and welder mounted on a truck used for repairing county machinery.

THE portable electric welder shown in the accompanying photographs and described below has proved to be a most valuable piece of shop equipment, and I very highly recommend a similar welder for all municipal shops which have various types and kinds of machinery to keep in running order. This welder was assembled in our own shop by our own mechanics, and a like job can be done in most municipal shops by the personnel there employed.

In assembling this unit we first purchased a second-hand, 1½-ton Chevrolet truck and overhauled it from one end to the other. We then purchased a used Hercules 6-cyl. motor of 85 h.p., overhauled that and put it in good running order, and then mounted it on the rear end of the Chevrolet truck and connected it to a G.E. 200 amp generator, which produces the juice used in welding.

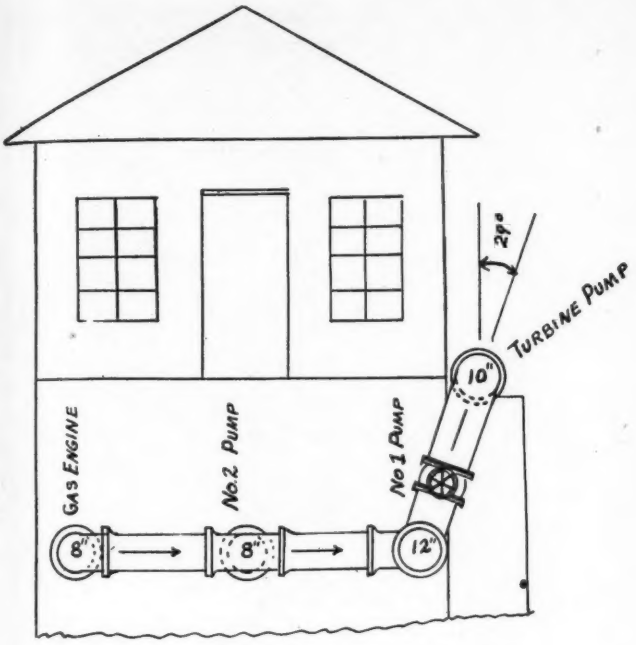


The welder ready for service.

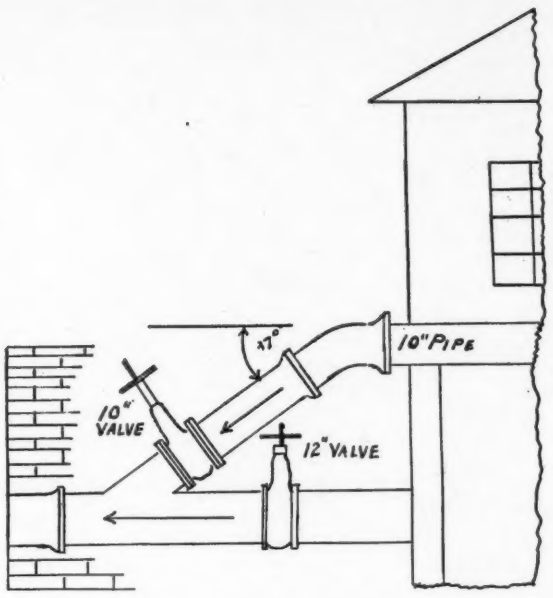
This generator was purchased new and comes equipped with amperage and voltage controls so that adjustments can be made for most any type of electric welding.

The whole assembly has proved to be most satisfactory. We have used it for innumerable jobs about the shop as well as on pieces of machinery needing repair in the different locations in the county. At present it is being used by our mechanic to weld together short pieces of I-beams to make them of proper length for a 36 ft.-span bridge. We welded similar I-beams last year for use on a 24 ft.-span bridge with perfect success.

The unit carries on one side a set of tanks which are used for cutting. At the rear of the machine is attached a grinder, which consists merely of a power take-off from the front end of the Hercules motor and a wyco flexible shaft with carborundum wheel and hand guards. This is very convenient, as most welding needs some smoothing, either of the part to be repaired or the weld itself. The Hercules is also equipped with a governor so that suitable speed is maintained at all times.



Front elevation showing pipe connections.



Side elevation of valve pit showing connection of 10-inch pipe to Y.

Installing a Turbine Pump at Roxboro, N. C.

By C. M. ABBITT

City Engineer

Detail description of process of installing a pump and the piping for connecting it to existing discharge main.

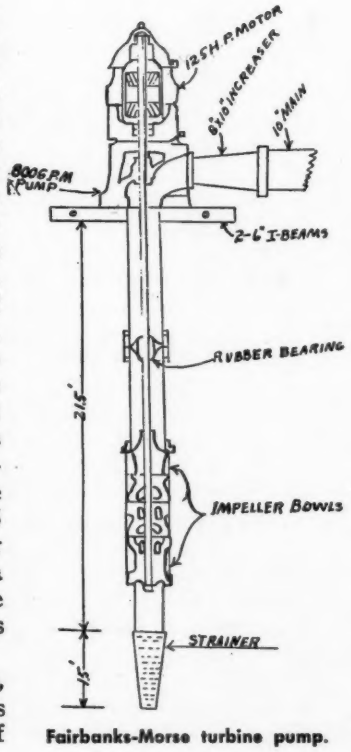
ROXBORO, N. C., is the county seat and located in the north central part of Person County, N. C. about ten miles from the Virginia line. The elevation is 664 ft.; population 4,600. The government is the city manager-five commissioner type.

In May 1942 the city officials and I decided that we needed more pumping capacity for our water supply. In May 1924 a pump, called our No. 1, was installed; a 4-stage 500 gpm Morris pump driven by a 100 hp. G.E. motor, both mounted on the same bed plate and connected by a 6-bolt coupling. This supplied raw water to the filter plant until 1936, when we purchased a 2-stage 600 gpm Morris pump, mounted on the same bed plate with a 100 hp G.E. motor and flange-connected to it. This we call pump No. 2. These, with a 150 hp Sterling gasoline engine-driven emergency pump made up our total raw water pumping equipment, which was installed in an engine room seven feet below lake level.

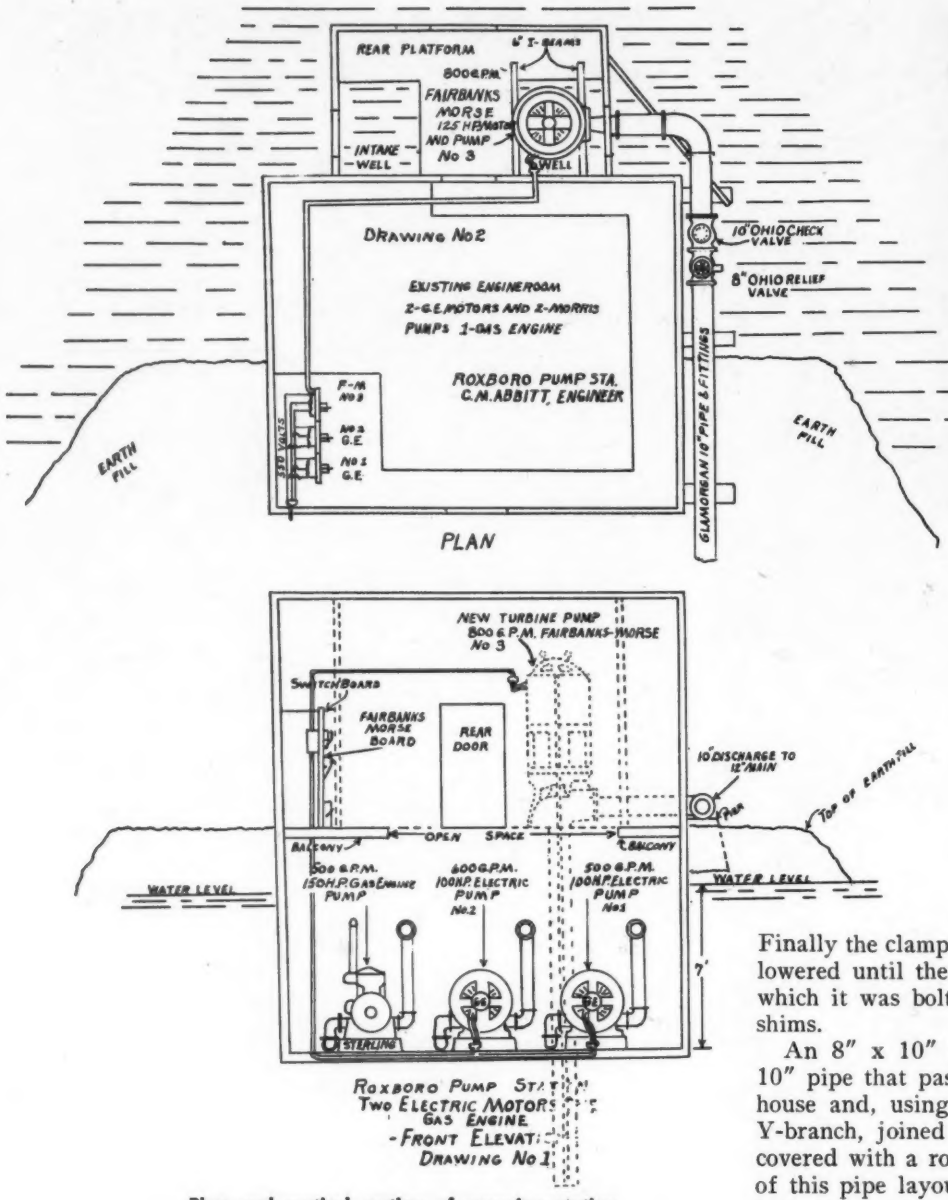
Both the electric pumps discharged into the same 12" main, and we had expected to operate both together to supply peak consumption. But this did not work out so well; at times the pump with the higher efficiency would exert more pressure than the other and close its check valve, even when the latter pump churned the water inside it until it got hot.

We figured that we needed a single unit with a capacity of 800 gpm, mounted above the lake level so that a burst intake pipe could not flood all the pumping units. The pump house is built in the lake, near the edge of the water, which surrounds it except for an embankment between it and the shore, which serves as a roadway. At the rear of the superstructure was a concrete platform on the same grade as the balcony inside, which served as a roof over the intake well, and it was decided to use this to support the motor of a vertical pump. An order was placed with Fairbanks-Morse Co. for a turbine pump driven by a 125 hp motor, to deliver 800 gpm against a head of 510 ft. to the filter plant 3½ miles distant.

To install the pump, I placed two 6" I-beams 6 ft. long across one of



Fairbanks-Morse turbine pump.

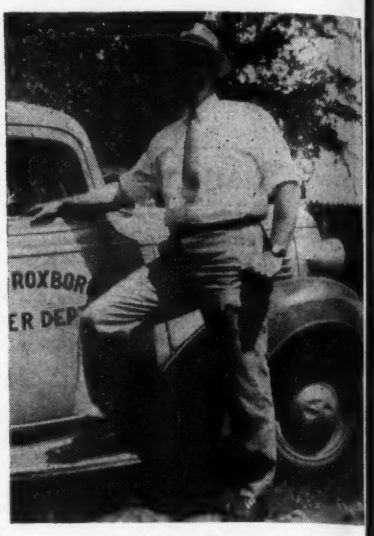


Plan and vertical section of pumping station.

the openings in the rear platform, one end of each being embedded in the wall and the other resting on the platform. These were spaced the proper distance apart to permit the pump head to be bolted to them, and held at this spacing by a piece of ¾" galzanized pipe at each end, a bolt passing through each pipe and the webs of the I-beams.

The 18" strainer was screwed to the bottom of the assembled impeller bowls, and a long 6" x 8" oak clamp was fastened around the top of the assembly, which was then lowered between the I-beams by means of an overhead hoist until the clamp rested upon the beams. Then the second section of the stainless steel shaft was screwed into the bronze coupling and the corresponding section of column was lowered over it and bolted to the lower section.

Another oak clamp then was fastened near the top of this column, the first clamp removed, and the assembled parts lowered until the second clamp rested on the beams. The "spider", or rubber-lined bronze center bearing, which holds the shaft in the center of the column and prevents vibration, was put in place. The final section of drive shaft, long enough to pass through the motor, was screwed tightly into the bronze coupling and any burr made by the wrenches



C. M. Abbitt, City Engineer.

carefully filed off. Then the last length of column was lowered over this shaft and bolted to the column below, with the spider fastened between them. Another clamp was fastened near the top of this column and it was lowered as before. Then, with the clamp resting on the beams, we lowered the pump head over the shaft, placing a gasket between the head and the column flange, and fastening the two together with stud bolts. Finally the clamp was removed and the whole assembly lowered until the pump head rested on the beams, to which it was bolted after being leveled by means of shims.

An 8" x 10" increaser connected this pump to a 10" pipe that passed around the outside of the pump house and, using a 45° bend and a 45° 10" x 12" Y-branch, joined the 12" main in a brick-walled pit covered with a roof of 2" oak planks. The calculation of this pipe layout, with its combined deviation from both line and grade, was an interesting problem in geometry. In the 10" line, which was furnished by the Glamorgan Pipe and Foundry Co., was placed an "Ohio" check valve and relief valve, and, bolted to the 12" x 10" Y, a 10" gate valve. This Y was inserted in the existing 12" pipe by cutting out a section by means of a welding torch. The pipe around the building is protected by a boat shed. Water between the check valve and the pump is syphoned back into the well when the pump is stopped.

The new pump was enclosed by building an 8" wall around the three exposed sides of the platform, with a lean-to type of roof, in which is an opening directly over the pump so that it can be hoisted for repairs, a hinged door covering the opening.

A control board for the Fairbanks-Morse pump was mounted in line with the two existing panels. On each control board is a push button start-and-stop switch. A pair of 2" conduits carry the six wires to the motors. Four small wires connect to remote control switches at the filter plant 3½ miles away, permitting the operator there to start or stop any of the pumps.

When the installation of the turbine pump had been completed, it was started first from the pumping sta-

(Continued on page 56)

Approach to head house of Princeton's sewage treatment plant.

Landscaping Sewage Treatment Plants and Sewers

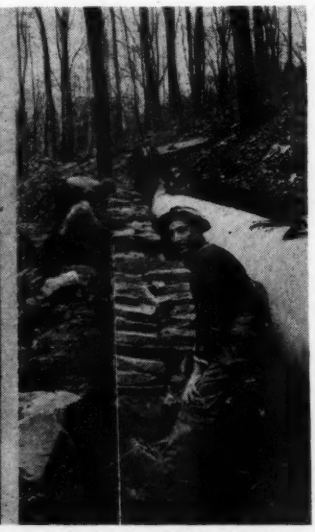
By I. RUSSELL RIKER, C. E.

Engineer for Princeton Borough, New Jersey

What Princeton Borough has done to make the grounds of its treatment plant a matter of local pride, and conceal the scars of sewer laying across private land.

LANDSCAPING is not usually connected with sewers or even sewage treatment plants; but by landscaping them we can make them more pleasing and so offset some of the natural unpleasantness usually associated with such structures. Few municipalities set aside much in their sewer budgets for landscaping, so that the superintendent or operator has to work his landscaping in the best he can.

Embankment over sewer line 30 days after landscaping.



Wall for retaining side-hill cover.

Sewers

It is sometimes necessary to run sewers, particularly trunk lines, through private property and often through estates that have been carefully landscaped. No one is anxious, few are even willing, to have sewers run through their property without an agreement that the property will be left in as good condition as before. Sewers must follow a grade and as a result sometime run out from under the ground, particularly in crossing a ravine, where they may be supported on a trestle. An inverted siphon may be constructed, but siphons are not desirable, particularly for short crossings. It is therefore necessary to do some landscaping of the sewer, as most property owners want no sign of the sewer above ground.

In laying the trunk sewer for Princeton, N. J., over fifty private rights of way were secured and a very careful agreement was made relative to putting the property back in good condition. Many small ravines were crossed and in nearly every case they were treated as shown in the photographs. Natural drainage was provided for by culverts, the sanitary sewer was laid on masonry support, and the entire work covered

Culvert laid under sewer crossing.

except the headwalls of the storm drain, and they were made attractive by using special building stone. Take notice how dry wells are built around each tree. It was almost worth your life to cut down a tree, and great care was taken to tunnel under trees and through tree roots, the trees meantime being braced by cables.

Where part of the pipe line was on the surface, it was always covered, care being taken to avoid the formation of pockets in the natural drainage; in some cases the land was graded back nearly one hundred feet for this purpose. All such places in fields were sown with grass seed, while on hillsides in the woods, dry stone walls were laid along the lower side of the pipe line to hold the fills. In some places, especially on the wooded property of the University, paths were made on the new fill over the sewer. On one estate a road was constructed over the sewer. Along and immediately above Carnegie Lake the sewer line ran through a red shale outcropping, well seamed, with no dip and with nearly horizontal strata, and drilling had to be done with great care to keep from blowing the entire section into the lake, which would have irreparably ruined the artistic appearance of the spot.

One thing we insisted on was that manhole covers be left exposed and ventilated, although many requests were made, especially on a golf course, to cover the covers with from 8″ to 12″ of top soil. A sewer must be well ventilated; closing up the holes in manhole covers invites trouble.

Treatment Plants

Even more important than the sewer is the landscaping of the treatment plant. No matter how carefully the plant has been designed to prevent a nuisance, nobody wants a sewage plant anywhere in their neighborhood. The plant operator therefore starts at a disadvantage, no matter how good he is. He therefore must make his plant as attractive as possible to offset some of the original antagonistic feelings in his neighborhood. I have seen sewage plants where the roses were so beautiful that people would come from long distances to see them. This is not the general rule but certainly is a credit to the operator.

Head wall of culvert under sewer.

The first item to consider is the area obtained for the plant. I believe there should be at least 35 acres, of which the plant structure may cover four or five acres or even less, the remaining being used for plant protection. (In Princeton we have a total of 90 acres.) These acres should be so planted and landscaped as to be as attractive as possible. If a fence is constructed, it should enclose only the units of the plant, leaving the outer boundaries of the property to be planted. Evergreens are probably the most economical and easily grown trees. We planted some 25,000 red pines, white pines, and Norway spruce seedlings obtained from the New Jersey State Department of Conservation and Development and nearly all lived and after ten years they make a fine showing.

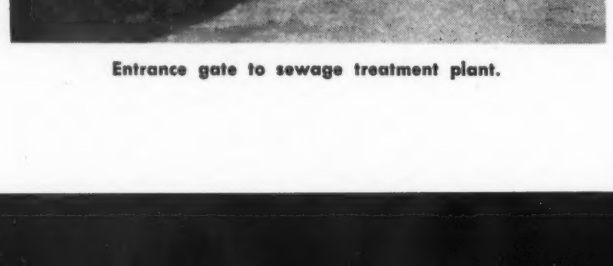
Plant the road leading to the plant with shade trees with here and there a clump of shrubs. Our entrance road is lined with elms, and a neat white gate is located just off the main road. The pumping station and operating house are attractive buildings with ornamental evergreen planting. The pumping station along the main road is particularly attractive, and few would believe it part of a sewage treatment plant. Neat little brick rubbish containers in which the rubbish can be burned are located along the main road.

To save the labor of cutting grass, have as little lawn as possible, especially on embankments. One of our embankments surrounding the digestion tank is covered completely with forsythia and the others with barberry. The shrubs soon cover the area.

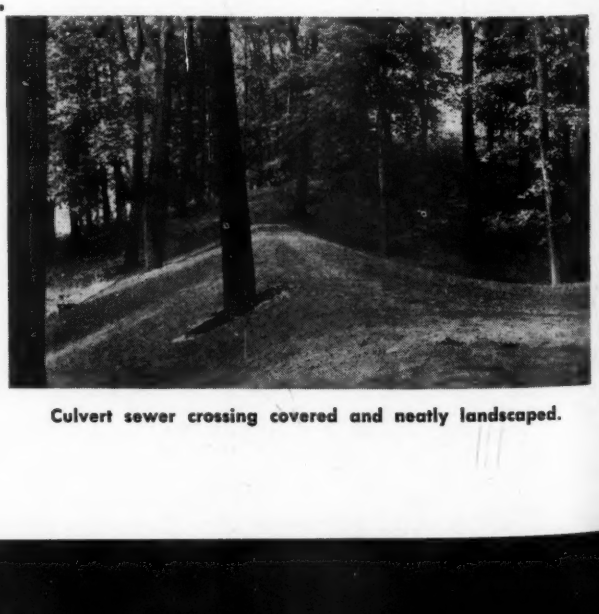
Roads and paths should be carefully made and kept in neat condition. In Princeton all roads about the plant are lined with shrubs of various kind. They require very little care.

I believe the most important part of the landscaping is the stream into which the effluent discharges. If it is of such size that it can be used for boating and wading, particularly above the outfall, such use of it should be encouraged. The stream should be kept clean of debris. In Princeton, the area along the Millstone

(Continued on page 50)



Entrance gate to sewage treatment plant.



Culvert sewer crossing covered and neatly landscaped.

A section of the resurfaced pavement.

Typical condition of old brick pavement.

Resurfacing Winchester Ave., Ashland, Ky.

By C. M. FERGUSON
City Engineer, Ashland, Ky.

Worn-out pavements thirty-five years old resurfaced for 2½ miles with bituminous concrete. Methods of construction and results obtained.

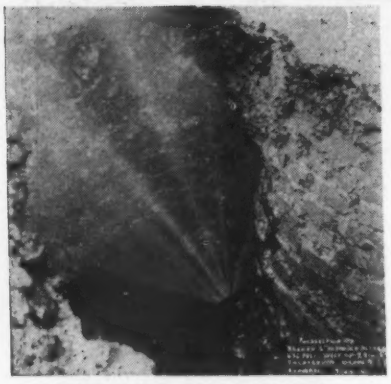
ASHLAND, Ky., is a city of the second class with a pre-war population of 30,000. Its main traffic artery, running through the business section from the western city limits to the eastern, is Winchester avenue. This avenue was paved, between 1905 and 1921, with 5¼ miles of brick laid on a concrete base and sand cushion. That from the western city limits east to 3rd street is still in place. Between 3rd and 6th streets and east from 37th street to the city limits the original brick was replaced a few years ago with a wider concrete pavement. From 6th street east to the C & O underpass near 37th street the original brick pavement was resurfaced this spring with hot mix bituminous concrete. This 2¼ miles, which varies in width from 40 to 64 ft., having been down for some 35 years, has taken terrific punishment in the form of necessary utility repairs, trolley track installation and removal, floods, and expansion blow-ups, in addition to heavy traffic and general maintenance. This pavement had been cut up and repaired so many times in so many places (practically all repairs were made with reclaimed brick), and was so full of depressions, humps, holes, bumps and what-have-you that it was difficult to clean and far from a pleasure to ride over.

Two years ago the city had some outlying streets resurfaced with hot-mix bituminous concrete, which was such a popular success that we decided to use it on Winchester avenue. The state had agreed to take over strategic highways where they passed through cities and maintain them as a national defense measure at no expense to the cities. Winchester avenue, as a part of U. S. 23 and U. S. 60 and a main traffic route to Ohio, West Virginia and eastern, western and central Kentucky, was unquestionably a strategic highway, and we satisfied the state highway officials that a request for this repaving by the state was well founded; and last summer the state let a contract to the Middle States Bituminous Corporation, of Ironton, O., for laying a Class 1 Bituminous Concrete pavement.

The construction was performed as follows: The street was first broomed (and washed where necessary) clean; then an asphalt prime coat of Ky. P.A.C. No. 5 was applied with a distributor at the rate of 0.10 gallon per sq. yd. (In the gutters this prime coat was broomed on to avoid the distributor spraying the curb.) A hot-mix levelling course or binder was then laid with a Jaeger bituminous paver in uniform strip widths to conform with the overall width of the street, this

(Continued on page 50)

C. M. Ferguson, City Engineer.



Broken 6-inch main discharging 100,000 gpd.

Background of Philadelphia

By MARTIN J. McLAUGHLIN

Chief, Bureau of Water, Department of Public Works, Philadelphia, Pa.

THE Bureau of Water of the City of Philadelphia is today one of the world's largest public utilities, yet it had very humble beginnings. In 1798 Benjamin Henry Latrobe was employed to survey the possibilities of constructing a municipal water works system, his recommendations were adopted, and three years later pumps started to take water at the Chestnut Street wharf on the Schuylkill river and the Bureau of Water came into being. In 1815 a steam pumping plant was built further up stream, at Fairmont, where the water was purer.

Later, Philadelphia absorbed many adjacent communities, some of which had water supplies of their own, and thus the city became possessed of several pumping stations along the Schuylkill river and one or two on the Delaware river. Some of these it inherited and some of them it built, but all stations now in use were constructed by the Bureau of Water. These two rivers still remain the source of supply for Philadelphia.

With the industrial development of the Schuylkill river watershed, the woodlands were largely cut over, with the result that the minimum flow of the stream kept decreasing. Moreover, the quality of the water became poorer and poorer as the amount of industrial wastes discharged into the stream increased. In fact, there is on record an action of Council asking the Chief of the Bureau to refrain from any further public discussion of the pollution situation, as it was giving the city a bad name. This reduction of the flow in the Schuylkill river caused an increase in the amount of water taken from the Delaware river, and the increase in contamination led to the filtering of both supplies. Filtration started on a partial scale in 1899 and by 1911 all water pumped into the system was filtered.

In reading back through the old annual reports, as well as some of the special reports, of the department, one is impressed with the continual reference to the existence of waste in the system. These complaints go back as far as 1875 and perhaps even further. Numerous studies were made comparing the per capita consumption of water in Philadelphia with that of many other cities and all seemed to conclude that Philadelphia used at least 25 percent more water than could be justified. They urged that measures be taken to curb this waste, and one report predicted that if this were not done the consumption of water by 1940 would be about 575,000,0000 gpd. In his 1883 annual report, Col. William Ludlow, then in charge of the department, estimated that 40 percent of the pumpage went to waste. These reports make it clear that by "waste" is meant not only the wilful waste of

Abandoned ½-inch service discharging 20,000 gpd.

water by the consumer, but the loss from defective fixtures and underground leaks of the mains and services.

At the turn of the present century the average daily consumption was above 300,000,000 gallons per day. At present, 40 years later, it does not greatly exceed that amount. This halt in the increase of the daily pumpage has been the result of several factors, such as a slowing up of the population increase, the installation of meters on about 220,000 of our 460,000 services, conducting water waste surveys for the detection and repair of unknown underground leaks of the mains and services, and house-to-house inspections for the control of fixture waste.

It is well that this growth in demand has been stopped, as our plant capacity does not greatly exceed the present consumption rate. Engineers are now working on plans for the expansion of facilities, and funds for this expansion have been made available by an $18,000,000 bond issue; but due to war, materials for building these extensions are difficult to obtain. We are, therefore, doing the best we can to keep the demand for water within the available supply.

Steps to Conserve Water

The demands of the war effort have greatly increased the use of water in this area and it is very probable that our facilities would have proved inadequate on some recent days of peak demand had it not been for steps which were taken to conserve the available supply. These steps consisted of (1) a publicity campaign by radio, newspaper, leaflet and poster to acquaint the consumers with the seriousness of the situation and advise what they could do to help; and (2) a Pitometer water waste survey to locate the hidden underground leaks. So successful have our efforts in this direction been that the W.P.B. has announced its intention of making a drive everywhere in the coun-

esent Water Waste Control Program

Water waste surveys and stopping of leaks found, and installation of meters, enabled Philadelphia to save over twenty million gallons a day, a fourth of which was due to leaks from abandoned services.

try to conserve water based in large measure upon our experience in Philadelphia.

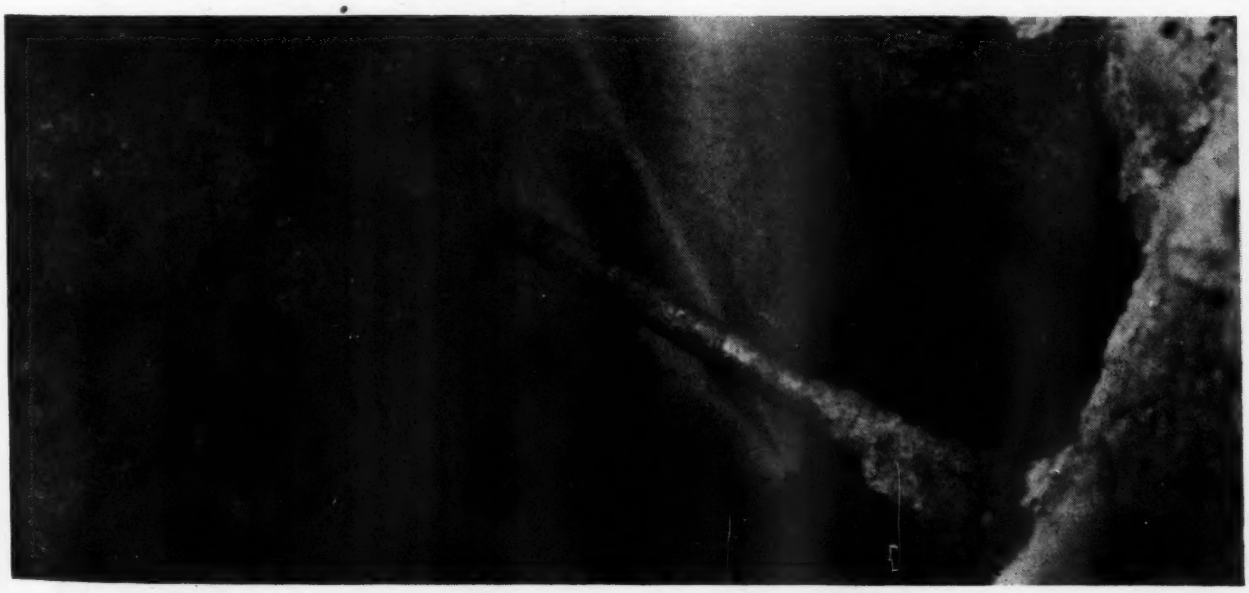
Recently (August 15, 1943) the Philadelphia Sunday Inquirer published in its rotogravure section an eight-page illustrated article telling of this work and particularly emphasizing the importance of the Pitometer survey as a factor in our campaign.

The Bureau of Water officials have long realized the importance of such surveys in any programs of water conservation. Between the years of 1926-1931 a complete survey of the Philadelphia system was made by the Pitometer Company engineers. This survey resulted in the locating and eliminating of 35,000,000 gpd of underground leakage, 50,000,000 gpd of house waste, and 4,750,000 gpd under-registration of industrial meters. So it was that, early in 1940, when our national defense program was just getting under way, the City of Philadelphia made arrangements with the W.P.A. to furnish the necessary labor involved in making such a survey and again contracted with the Pitometer Company to furnish the necessary engineering services, equipment and supervision. The work proceeded on this basis until early in the present year, when W.P.A. went out of existence. Less than half the city had been covered, but by that time the necessity for continuing the work had been more than demonstrated and the Director of Public Works asked for and received from Council and the Mayor the funds for supplying the labor which had previously been furnished by W.P.A. so that the survey might continue. There was no serious hitch in making this change over and the survey is proceeding smoothly. Day after day additional savings accrue to the city from this work. Up to the first of September of this year, with the work a little over half completed, this survey has resulted in the following savings:

500	Live service leaks	3,909,000 gpd
356	Abandoned service leaks	5,058,000 gpd
63	Joint leaks	2,125,000 gpd
54	Broken mains	6,139,000 gpd
15	Miscellaneous leaks	333,000 gpd
988	Leaks	17,564,000 gpd
40	Slow meters	3,609,000 gpd under-registration
3	Cases of unauthorized use	647,000 gpd
		4,256,000 gpd
	Total saving to September 1st	21,820,000 gpd

This is enough water to supply the normal needs of a city of 200,000 persons and unquestionably these savings have been a large factor in our ability to maintain normal operating conditions.

In addition to this, the financial benefits to the city have been considerably in excess of the cost of the work. In the matter of coal alone, we require about a ton and a half for every million gallons of water



Leak on abandoned ½-inch service discharging 15,000 gpd.

pumped. The 22 million gallons saved would have required 33 tons per day, or more than 12,000 tons per year. Coal is now a critical material and so are the electric power and purification chemicals which have also been saved.

Included in the preceding table, but not readily apparent, one will find several items of interest. Pictures taken of several of the broken mains show that other utilities such as the sewer department, light company or telephone company had built masonry structures over or around our mains. The subsequent settlement of these structures resulted in broken mains and serious leakage. This situation is particularly bad as these utilities usually have drains or conduits in connection with their construction which carry the water away so that it does not come to the surface where it would disclose the existence of the leak.

But particular attention is drawn to the item of "abandoned services." So far the present survey has located 356 of these, leaking 5,056,000 gpd. If an equal number is located in the remainder of the system, this indicates that the survey will uncover about 700 of these, wasting about 10,000,000 gpd. Moreover, these were only the abandoned services which had failed in the fourteen years since the preceding survey, and which had not revealed themselves by water showing at the street surface. This shows conclusively that present regulations regarding the abandonment of services are inadequate. It should be required that all abandoned service be dug up and shut off at the main.

This situation has arisen as the inevitable result of our growth from a small city to a large metropolis. Sections which were once entirely residential, with services for every lot, have had the houses torn down and replaced with large factory buildings or apartment houses which cover an entire block, sometimes more, sometimes less. One large service is sufficient for the needs of the new building and the old services have been cut off at the curb. As a result, when these services failed the leak was undetected unless the water came to the surface.

Leaks on live services frequently are noisy and when they get very large cause a reduction in service pressure so that a complaint is made, but the leaking abandoned service causes no direct inconvenience to anyone, so it continues to exist and to grow until it is uncovered by a survey such as we are having made. These leaks can be very large, individual leaks of this nature having been located discharging more than 100,000 gpd. Perhaps we may be able to take advantage of some future W.P.A. to cut off at the main all such services of which we have a record.

So it is that Philadelphia is successfully meeting the present crisis. The Mayor, the Council, the Director of Public Works and, most important of all, the citizens of the city are behind us in our efforts to continue to provide the city with a sufficient quantity of pure, wholesome water. And even though badly needed material for expanding the supply is not available under war conditions, we have every hope that we will continue to meet the demands made upon us.

Paint Shows Valve Locations

The Water Department of Lewiston, Idaho, has painted a sizable ring with yellow traffic paint around each valve cover throughout the city to facilitate locating it quickly. Two books are kept, at opposite sides of the city, containing sectional maps with referenced valve locations.

Solder For Lead and Copper Pipes

"Conservation of Tin in Soft Solders" was the subject of a paper and discussion before the July meeting of the American Society for Testing Materials, a part of which is of interest to water works men and others who use soldered joints in lead and copper pipes. Concerning wiping solders the authors of the paper, D. L. Colwell and W. C. Lang, of the Conservation Division, War Production Board, said:

"With wiping solders, usually used in joining lead pipe and lead cable sheathing, the solder is applied to the prepared joint in a molten condition and chills rapidly, becoming pasty. It is caught on a leather or cloth pad and the pasty solder is then manipulated with the wiping pad to form the joint. Excess solder is removed before it is completely solidified. British practice confines the tin content of wiping solders to a 30 per cent maximum. In this country it is frequently claimed that solders containing less than 38 per cent tin are unsuitable for wiped joints on pressure water lines. In view of the British practice and also in view of the desirability of a wide freezing range for best wiping conditions, the necessity for more than 30 per cent tin seems very questionable. A 30-70 tin-lead solder has the same solidus as a 40-60 tin-lead solder, and a considerably higher liquidus, giving a wider-freezing range which should be more desirable for a wiping solder. The addition of 2 per cent antimony is said to improve the consistency of the pasty solder.

"In many cases wiping solder may be entirely eliminated by the substitution of lead welding. Classes to teach plumbers the technique of welding lead by use of the oxy-acetylene torch have been formed in many trade schools. Wiped joints in lead pipe or fittings which are ordinarily made on the bench could very readily be welded, thus eliminating the wiping solder entirely. It is also possible by a study of joint design to reduce greatly the amount of wiping solder required. By a study of splices, the Western Union Telegraph Co. was able to reduce its solder consumption for this purpose by more than half. In addition to this, tin contents were lowered and trouble with leaky splices due to porosity was greatly reduced."

In the discussion, C. A. Hill of the Mueller Brass Co. said:

"This discussion has covered nearly all uses of solder except one which has become prominent in the past 15 years; that is, the joining of copper tube and fittings. This tube ranges in size from very small, through the sizes used in house piping, to the larger sizes up to 12 in. in diameter used mainly in paper mills.

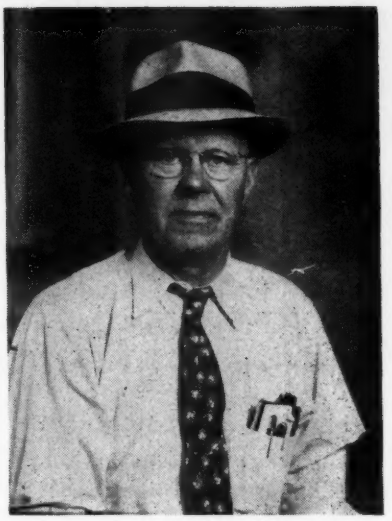
"A satisfactory solder for this use must have adequate shear strength, ample resistance to 'creep' at the temperature in service, and, what is important it must 'flow' or spread readily to insure the complete filling of the joint. Solders with 40 per cent or more tin satisfy these conditions. Since these are not now available it is fortunate that the development of the lead-silver solders has given a workable substitute. The shear value and 'creep' resistance of these lead-silver alloys is satisfactory.

"Many users do comment on the higher fusion temperature and the less free flowing qualities both of the lead-silver solders and low-tin lead-base solders now being made. However, there is a notable absence of complaint as all recognize that these new solders will serve their present purposes and have released tin for more important needs."

Walnut Bottom Run Improvement At Beaver Falls

By D. F. HARVEY
City Engineer

Using W.P.A. labor and city-furnished equipment and material, city builds 3,500 ft. of flood-prevention channel.



D. F. Harvey, City Engineer.

WALNUT BOTTOM RUN flows south through the City of Beaver Falls, Pennsylvania, for a distance of about two miles and empties into the Beaver river at the southerly end of the city. It is covered by a twelve-foot arch for about one-half mile from the river, and beyond the arch it is bridged at the cross streets. The streets of the city run east and west and are numbered, beginning at the south end of the city.

A few months after my appointment as city engineer, in May 1938, we had two very heavy rain storms and the run overflowed its banks from Eleventh Street to Twenty-fifth Street, causing serious damage to industrial plants located near the run and causing the city heavy expense cleaning the mud and debris from the sidewalks, streets, and storm sewer catch basins.

My recommendation to Council for authority to make a survey and prepare a W.P.A. Project for the improvement of the run channel was approved and actual construction work was started on April 2, 1940.

The run channel improvement consists of the construction of side walls, ten feet apart and five feet high, built of sandstone laid in cement mortar, and a pavement between them about twelve inches thick, slightly concave at the center. The stone was secured from a leased quarry about five miles from town and cost five cents a ton royalty.

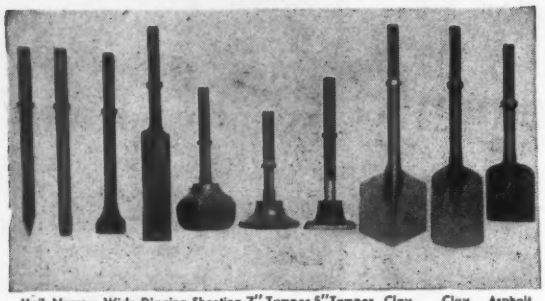
Finished improvement, looking north at 15th street.

Thirty-five hundred lineal feet of this improvement was completed in two and a half years with W.P.A. labor. The city furnished all equipment and material. During the first year and a half of construction we had a maximum of 75 men, but the force dwindled until we had only 15 men working; and as the channel improvement had been completed from Eleventh Street to Twenty-fifth Street, where the most serious damage from floods occurred, we closed the job down for the duration. The balance of the work may develop into a post war job.

This improvement has not only benefited the industrial plants along the run but has saved the taxpayers the considerable cost of cleaning the debris from the streets after each heavy storm.

An Airport for Every Community

The Civil Aeronautics Administration of the federal government intends to start the planning of a national system shortly after the first of the year, which contemplates the construction of at least a class two airport in every community of 3,000 population or more in this country. The question of how the construction is to be financed has not even been discussed, but unofficial thinking seems to be that it will be on the basis of a contribution on the part of the local community, the state, and the federal government, with the latter instrumentality bearing roughly 75% of the cost and the state and the local community bearing about 25% of the cost. Construction in some cases will undoubtedly start before the end of the war. Since in most instances these airports will be built on land owned in fee simple by the community, the responsibility for the maintenance and operation of the airport after it is once constructed will likewise rest on the community. If the advanced survey of the reasonable needs of the community has been carefully made and the type of facility constructed is not far beyond the normal requirements of the community, it can be expected that the normal operating revenue will be adequate to maintain the airport without placing an undue burden on the taxpayers. *Extract from an address by Leslie L. Schroeder, Commissioner Minnesota State Dept. of Aeronautics.*



Accessories for use with Cleveland Rock Drill Paving Breaker.

Trenching and Laying Sewer and Water Pipe

(Continued from page 11)

Contract construction is usually an economical and satisfactory method of performing the work, provided proper plans and specifications have been prepared and that these be based on sound engineering data and knowledge. Without such plans, contract construction is often or usually unsatisfactory.

4. Departmental Work.—In many communities a "water gang" or a "sewer gang" is maintained to make repairs, lay short extensions and do similar work. Local conditions will generally determine how large a job they can be used on economically and satisfactorily. Factors to be considered will be (a) the number of men able to act as foremen; (b) the amount and type of construction equipment and tools that are on hand; (c) the size of the job, the necessity for speed in construction; and (d) whether or not the "gang" can be spared from their routine duties. It is seldom desirable to attempt any large job with departmental labor. The local water works or sewerage superintendent will usually be the best judge of this, but he should never let his desire to construct a large and important job tempt him beyond his capacity.

An engineer is necessary on all important jobs. Important hydraulic problems are often involved in seemingly simple interconnections or extensions to serve new areas. Technical advice is available at a very low price considering the money and embarrassment it may save. Also, it is necessary that the municipal gangs follow sound and approved practices in construction—such practices as would be required of a contractor if he were to perform the work. Unsatisfactory work is not a good investment, irrespective of who does it.

The writer knows of many cases where superintendents who were very capable as such, but were not engineers, were reluctant to call in an engineer on a moderately difficult job, and went ahead "on their own." The usual result was trouble and loss of reputation—in some cases also loss of their jobs.

5. Force Account Work.—By force-account work is meant the hiring by the municipality of a force of workmen, the provision of necessary tools and equipment, and the carrying on of the work just as it would be done by a contractor. When handled by a capable and experienced superintendent, assisted by a group of skilled foremen, and when adequate construction equipment is available, this method may be very efficient. An engineer is just as necessary as when the work is done by a contractor, and he should prepare plans and specifications which should be followed as faithfully as they would be by a contractor. Slipshod work should never be permitted.

Provided that a qualified superintendent and foremen are available, the selection of this method may depend upon how much equipment additional to that on hand will be needed to do the work properly and economically. If the job is of such size that the special machinery needed will be worn out during construction, or if the municipality can utilize it effectively after construction has been completed, this factor is not important.

Special jobs sometime arise, in which all possible elements and factors influencing cost cannot be foreseen and provided for in the plans and specifications. In such cases, contract construction may not be feasible and force-account work will be necessary.

One defect in force account work is the tendency to employ as foremen local men who have not had adequate experience in this particular type of work. For that reason, full and clearly written specifications are necessary and a resident engineer should be present all of the time, just as though the job were being done by a contractor.

6. Planning the Work.—Whether the work is to be done by the department's men or by force account, careful planning is necessary. The number of men to be employed, the qualifications required and the organization of the gangs to do the various items of work should be considered. The period of time within which the job must or should be done is an important factor; also the tools and equipment required, and the scheduling of materials for the job so that delay will not occur due to their lack. The necessary engineering surveys and planning must be done, lines and grades computed, and specifications or construction directives prepared to govern the details of the work. Foremen should be drilled thoroughly in the construction requirements laid out in the specifications, especially those men who are not thoroughly familiar with this type of work; and all foremen and superintendents should be required to study both plans and specifications in advance of starting construction.

7. Equipment.—Special equipment may be required for excavating the trench, as trenching machines, power shovels or draglines; for cutting through the pavement and for rock excavation, as air compressors, drills and pavement breakers; for handling the pipe, if large cast iron, steel or concrete pipe is to be used, as cranes and specially built truck bodies; for driving sheeting, as air or steam hammers; for building forms, as electric saws; for backfilling; and for other out-of-the-ordinary jobs. There may also be needed furnaces for heating pipe-jointing material; jointing tools; concrete mixers; trucks for hauling materials and sometimes workmen; tampers; hand tools; timber; cement; sand and coarse aggregate; tool boxes; barricades; torches; red lights; and many other items. The need for these, and the number of each likely to be required, should be carefully considered well in advance of construction. Most communities have standard practices in regard to purchase of equipment and materials. Such standard practices should be followed, but care should be taken to insure that the exact material or equipment needed is obtained and that specifications do not permit substitutions of unsuitable supplies. The rental-purchase method may be considered.

8. Organization.—The organization of the men into gangs suitable to perform the work economically should be planned carefully. In general, even on ditching, gangs should be relatively small—generally not over 12 or 15 men. The number and size of gangs

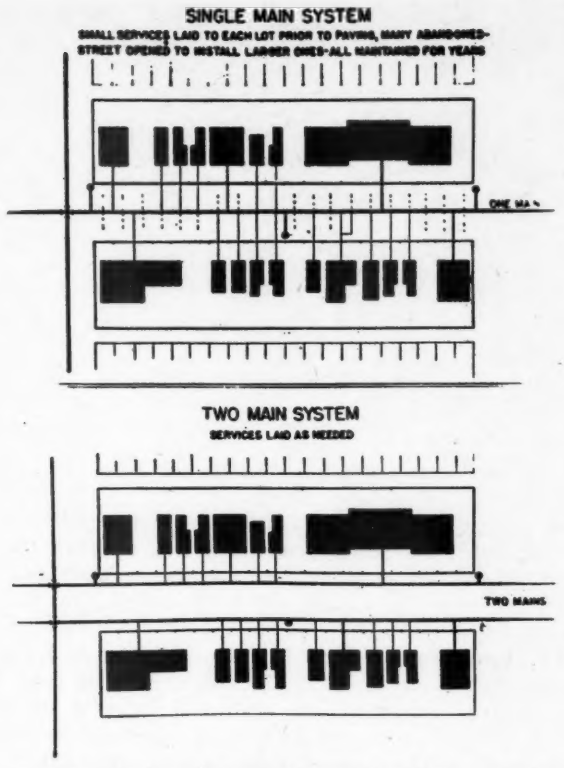
and the scheduling of the work depends on many local factors. In city streets, long stretches of open trench are undesirable; but where the line crosses fields or is in little-used streets it may be permissible to open the trench a considerable distance in advance in order to permit drainage or for other reasons. Generally, however, this is not desirable, as the trench may cave in due to traffic vibration, wet weather or other reasons and, where sheeting is necessary, an inordinate amount of material will be needed. Therefore, it will usually be best to have the pipe laying gangs follow closely behind the trenching gang.

One or more gangs will be needed for trenching; a small gang—usually 2 to 4 men—will be needed just ahead of the pipe layers to finish the bottom of the trench for the pipe. Following the pipe laying gang (after the pipe has been inspected and tested), are the backfilling workmen (see details later for procedure in backfilling). This gang should make the streets or highways passable and safe for traffic, but pavement should not be placed until the fill in the trench has settled sufficiently to permit a lasting job. In many cities, the street or highway department replaces the pavement surfacing, charging the water or sewer department for the work. Otherwise, a representative from the street or highway superintendent's office should be present when the surface is finally replaced in order to assure this being done properly.

9. Engineering and Planning.—No job of any magnitude should be begun until accurate surveys have been made and engineering data are available. The necessity for specifications or other construction directives has already been stressed. On a sewer construction job, the grade or fall of each run of sewer between manholes, the location of each manhole and the elevation of its invert, and the line of each section of sewer joining the manholes must be determined. (The location of sewer lines will be discussed later.) Stakes should be placed at 50 or 100-ft. intervals along the lines showing their location and indicating the depth of cut; actual construction grades will be given during construction. When laying a water line, fewer engineering data are necessary, but the line between bends should be straight and there should be no high points in the line if they can be avoided, since air may collect in these and obstruct the flow. Other factors in connection with trenching are described in Part II; factors referring specifically to laying sewers are covered in Part III; and those relating to water line construction are treated in Part IV.

II. General Factors in Trenching

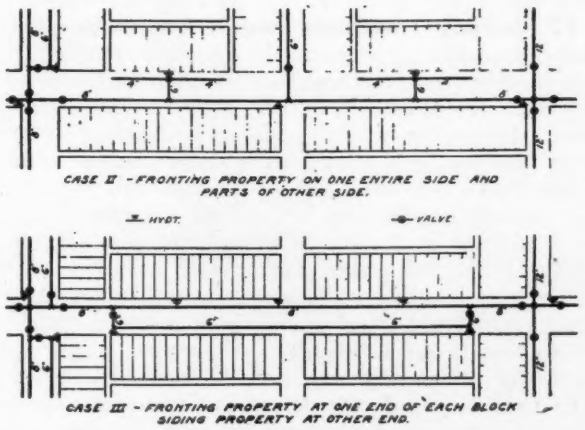
10. Records of Existing and Underground Structures.—Under nearly every street surface will be found storm water drains, sewers, water pipes, gas pipes, electric conduits, and often other structures. Very few cities have an accurate record of such underground utility lines; in quite a few, the more or less reliable memory of one or more of the older water or sewer gang workers must be utilized; in others, it is purely a game of chance. Even where it is known that water, sewer and other pipes are located in a street, the exact depth and distance from the curb or from the centerline of the street is likely to be uncertain; also the depth and slope of connections to houses. Sometimes, even manholes are covered over in street resurfacing operations. Therefore, when new construction is necessary, some of the existing pipes may be broken, or vexations and costly delays, sometimes requiring complete revision of plans, will result due to unforeseen obstacles.


SINGLE MAIN SYSTEM
SMALL SERVICES LAID TO EACH LOT PRIOR TO PAVING, MANY ABANDONED-
STREET OPENED TO INSTALL LARGER ONES-ALL MAINTAINED FOR YEARS
ONE MAIN
TWO MAIN SYSTEM
SERVICES LAID AS NEEDED
TWO MAINS

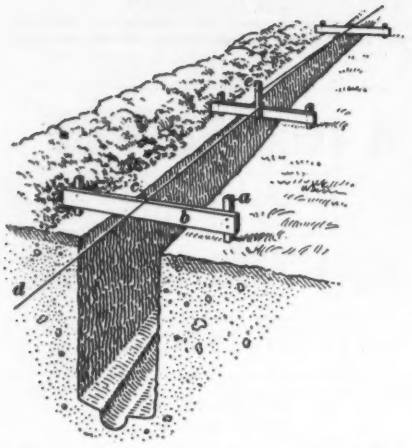
Service connections with the single-main and the two-main systems.

Every city or village ought to do its best to obtain the data necessary and make a record of all the pipes and conduits underneath its street surfaces. Such records should include distance from building lines, curbs or centerlines of streets, elevation of invert or top, size, material and purpose. Since alignment and grade are not always straight, the above data should be available at about 100-ft. intervals, though very few cities or villages can attain this objective.

Every new line that is laid should be carefully recorded. If a standard practice for each class of underground structure is adopted, recording will be facilitated. Local gas and electric companies usually keep an accurate record of the location of their underground lines and valuable information may be obtained from them. They should be consulted before a sewer or water line is planned. Their system of records should be studied and can often be used as a basis for installing and maintaining records of water lines and sewers.


CASE II - FRONTING PROPERTY ON ONE ENTIRE SIDE AND PARTS OF OTHER SIDE.
HYDT.
VALVE
CASE III - FRONTING PROPERTY AT ONE END OF EACH BLOCK SIDING PROPERTY AT OTHER END.

The two-main system as adapted to two cases.



Method of setting grade boards and string.

In general, all other municipal departments should be consulted: the street department for data on culverts, drains and storm sewers; the water department for water pipes, etc. Such previous consultation will often prevent much embarrassment.

11. Location of Pipe Lines.—In order to serve equally houses on both sides of the street, the center of the street appears to be the ideal location for a utility line. However, all such lines obviously cannot be located in the center of the street. On sidehill streets sewers are usually best placed nearer the downhill curb (details of sewer location are discussed more fully later) but in level areas there is no particular choice. The same is true of storm sewers; it makes little difference, as a general rule, where a water or gas pipe, or electrical conduit is placed, especially if the householder is required to pay for house connection footage only from the property line.

As a suggestion, water mains might be located in a fixed position, as 10 feet from the north and west curbs, for instance, on all streets where such position did not involve difficult construction, extra expense or special inconvenience to householders. Where a location elsewhere was required, special notation should be made in the records. Sanitary sewers, similarly, might be located in the center of the street, or a fixed distance offset from the center, as 3 feet south and east of street centerlines. This would allow storm sewers to be placed slightly offset in the other direction. Storm sewers are not usually placed as deep as house sewers and thus house sewers could pass under the storm sewers to connect to the sanitary sewer. Connections to the water mains do not need to be laid on a uniform grade, as do house sewers, and could pass either under or over the sewers.

12. Survey Methods and Accuracy.—The kind of surveys needed and the accuracy with which they must be performed depends so much on the character and size of the job that no set statement can be made. However, too much care and accuracy is far better than too little. Obviously a sewer extension one or two blocks long, where there is ample fall requires only enough engineering to provide a straight line and a uniform grade. On the other hand, a sewer line serving a flat area, with one or more branches may require very accurate surveys. In general, water lines do not require to be laid so exactly to grade.

This text is not intended to tell engineers how to survey for a sewer system, and, in fact, is designed to be used only for routine maintenance and extensions by superintendents and foremen. In general, lines more than one or two blocks long should be laid out by an engineer, with a transit. The survey should indicate the lines of the sewers, with distances to each street intersection, the elevations of the street surface at 50-ft. intervals, and the points with other sewers of junction. Stakes for permanent reference should not be located on the line, as excavation for the pipe will displace them. Stakes should therefore be set on an offset line, preferably always on the same side of the trench and distant about 2 feet plus one-half the width of the trench. On concrete streets, a mark may be made with a chisel; on most bituminous surfaces a spike or nail can be driven in; in dirt, a stake may be used. Witness marks at 100 ft. intervals may be placed at or near the curb, with station numbers as indicated by distances placed on them. For instance sta 5 + 56 indicates the stake is 556 feet from the beginning of the survey. Elevations should be to at least 0.01 (one one-hundredth) ft. A map should be provided showing the layout accurately as a guide for the foreman.

13. Line and Grade.—The general line of the trench having been laid out and strings drawn or the pavement marked to indicate the limits of the edges of the trench, provision must be made to give the exact line and grade. This is especially important in sewer construction, since sewers must run straight and at a uniform grade between manholes. It is best accomplished by grade boards. Substantial stakes are driven in pairs, one stake on each side of the trench and about 18 inches from it. On each stake is marked a grade point a convenient distance above the grade line of the pipe to be laid as 7.0 ft., 9.0 ft., etc., depending on the depth of the sewer. (The grade line is usually the inside bottom of the pipe, which is called the *invert.*) Such pairs of stakes are usually placed at 25-ft. intervals and are marked so that the grade point is the same distance above the grade line or invert of the pipe on all the stakes for as long a distance as possible. When the trench is ready for laying the pipe, a board with a straight edge uppermost is nailed to each pair of stakes with the top edge at the grade point and the top edge of the boards are then a known distance above the grade line of the pipe. The center line of the trench is then marked by a nail in the top edge of the cross-board, and a string is stretched tight between the nails. If all the boards on a given stretch of pipe have been placed 6.5 feet, for instance, above the invert of the pipe, the string stretched over these boards is parallel to and 6.5 feet above grade line. Therefore, the exact proper depth of the pipe can be determined at any point by measuring 6.5 feet down from the string. Not all boards can be placed the same distance above the grade. Where a change in this vertical distance is necessary, due to change in depth of trench, the crossboards and strings are varied as may be necessary. At the board where the change is made, a 1″ x 2″ can be nailed to the board with one edge at the trench center line and exactly vertical, and the change in grade point elevation measured off on this. Some engineers set all cross boards resting on the ground surface, nail to each a 1″ x 2″ with a vertical edge at the trench center and, using a level and rod, mark the grade point on each stake; then stretch the string between these 1 x 2's.

14. Width of Trench.—The width of the trench depends on the width of the pipe, except that even the narrowest trench should be wide enough to permit men to work in it, say 20″ to 24″. Unnecessary width means excess dirt to be handled. On the other hand, if a trench is too narrow the difficulty of working in it may add considerably to its cost. When the trench

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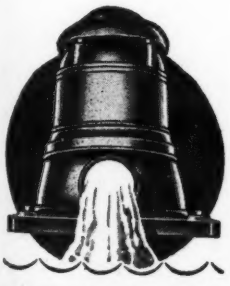

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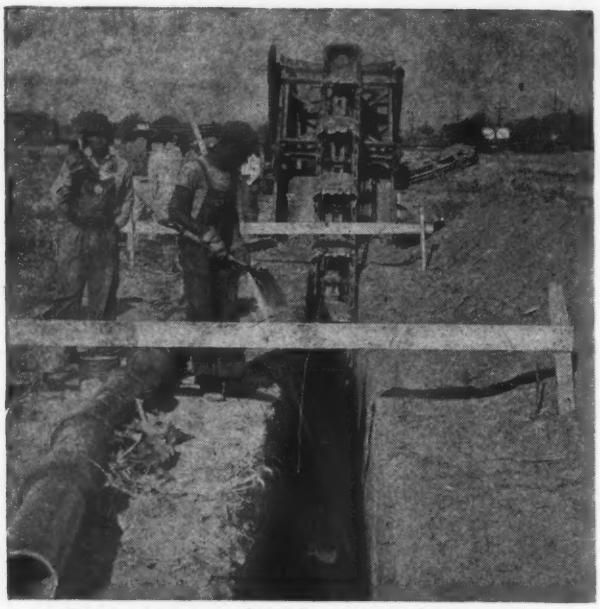

Constructing sewer lateral using trench excavator.

is for a sewer, the bottom of it should ordinarily be of such width as to provide a clear space of not less than 4 inches on either side of the pipe when this is less than 12-inch. For larger pipes, the clear space on either side of the pipe may be about 1/3 of the pipe diameter. (The outside diameter is about 1.2 times the inside.) Thus, the trench width for an 18-inch sewer would be about $18 + 6 + 6 = 30$ inches. The width of the trench closely affects the load on the sewer, and when the trench is deep, attention should be paid to this factor, but allowance should also be made for space required for sheeting. Both of these factors will be discussed in later paragraphs (21-23 and 38-39).

When laying water pipe, the trench is usually 12 ins. to 18 ins. wider than the pipe diameter. For a 12-inch pipe, trench width would be 24 to 30 inches. When using cast iron pipe, no concern need be given to the weight of the fill, but bell holes must be dug at each joint 6 to 10 inches wider on each side of the pipe. Steel pipe over 8 or 10 inches in diameter, when not under pressure, may be affected by the weight of the backfill in the trench over the pipe. Special consideration will be given in Paragraph 56 to trenches for water pipe.

15. Cutting the Pavement.—The line of the trench should be marked on the pavement surface. For cutting through pavement, if an appreciable amount of work is to be done, an air hammer or a gasoline operated hammer pavement breaker is almost essential. If only a very short strip of concrete must be opened up, hand sledges with short drill steel or sharp pointed tools may be used. Reinforcement should be cut off close to the exposed edge of the concrete. Black top pavement may be cut with a dull axe or a sharp-edged sledge, but again much faster and cheaper work can be done with an air tool. Points designed especially for this work are available for both air and gas-engine operated tools.

Concrete is usually broken in the process of removal and can not be replaced. Many types of bituminous pavement can be removed in strips or large pieces so that they can be used as a rough, temporary cover after backfilling and until the final surfacing is placed over the cut.

16. Trenching by Machine.—For digging trenches for long lines where the soil is free from rock and boulders, trenching machines are advantageous. Usually the work is done more economically and more speedily, and it is easier to manage a machine and an operator than a gang of men. Few cities own trenching machines, therefore a machine may have to be rented or the work done by contract. Where the volume of work is large enough and conditions are favorable for the use of trenching equipment, it may pay for itself on the one job.

In streets, the presence of gas or water connections to the houses usually creates some interference and may markedly reduce the efficiency of trenching machines. All of these small pipes must be located before the ditcher reaches them, and the cutting edge raised to prevent injury to them. If the trench is sheathed, the placing of the sheathing follows immediately behind the trenching machine.

A power shovel equipped with a trench hoe is effective in areas where there are small boulders and other obstructions. A standard shovel is used, but it is so equipped that the bucket can be used for digging even a deep trench.

For excavating wide trenches a drag line is sometimes used; the sides of the trench generally being sloped about 1 : 1 and no sheathing used. This is seldom practicable for city streets.

When considering the relative advantage of trenchers and power shovels, the width of the trench and the size of the pipe should be considered in connection with pipe loading (see Pars. 38 and 39).

17. Trenching by Hand.—Both sewers and water lines are usually constructed in open trench. In places where impediments exist that make machine

Boom type trencher digging shallow trench for water pipe.

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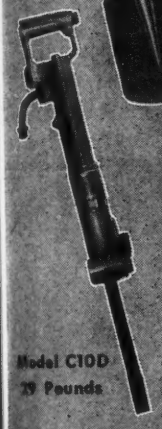

Model C10D
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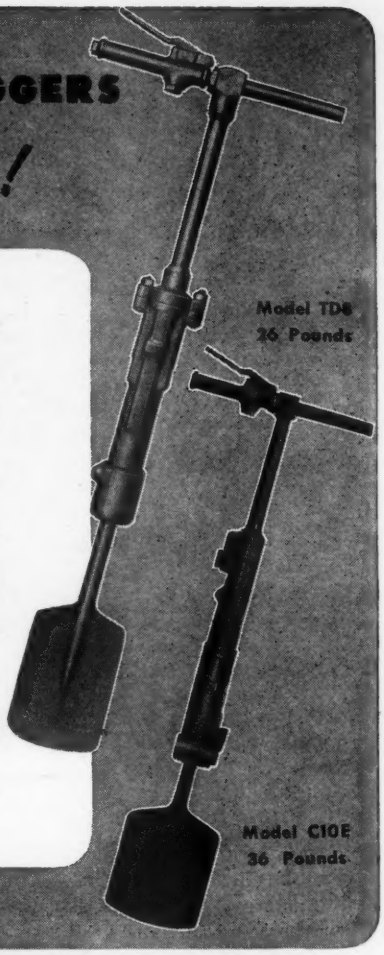

Model TD8
26 Pounds

Model C10E
36 Pounds

Cleveland No. 5 Back Fill Tamper weighs 30 lbs. with butt.

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Using platforms for shoveling dirt from deep trench.

trenching uneconomical, or on small jobs, trenching is done by hand. Picks and shovels are the principal tools employed, but crow-bars, axes for cutting roots and logs, sledges, drills, wedges and other small tools are often needed. If the ground is wet, rubber boots must be supplied to those men who must work in mud or water. The number of men needed and their organization depends upon the size of the job. On short extensions, four or five men may be sufficient. On long or deep lines, thirty or forty or more may be needed to maintain the required rate of progress. The men should be organized into appropriate groups or gangs, generally as follows: Cutting pavement, clearing brush or doing other necessary preliminary work (the line having been previously marked out); digging the trench, which is usually done in stages, each gang taking out a "lift" of two feet or so; and finishing the trench bottom for the pipe layers. Where sheeting is necessary, a special gang places this in connection with trenching.

When the trench is more than 6 to 8 feet deep, the workmen at the bottom cannot throw the dirt out of the trench. A stage or platform must then be built in the trench, about 5 or 6 feet below the ground surface. The man in the bottom of the trench throws the dirt onto this platform and another man standing on the platform then throws the dirt out of the trench. When the depth of the trench exceeds 12 or 14 feet, another stage is necessary. Thus, when the depth of the trench exceeds about 6 feet, all dirt must be handled twice and when it exceeds about 12 feet, dirt must be handled three times. This necessity for rehandling and the slowing down procedure inevitable under the circumstances greatly increases the cost of deep trenching.

All the dirt should generally be thrown out at one side of the trench—the left side of the men working; both because it is difficult for men (unless left-handed) to throw to the right, and because it leaves one bank free for passing pipe and other material into the trench, and for traffic to pass.

18. Using Buckets.—When trenches exceed 6 feet in depth, buckets may be used. These are of steel, holding 1 or more yards of dirt. They can be lowered to the bottom of the trench with a derrick or crane, filled with hand shovels and then raised and dumped into carts or onto the street. Such buckets can not usually be used in narrow trenches dug for small pipe, but are economical in trenches for large pipe where much dirt must be removed, as rehandling is eliminated. The buckets can be handled readily in sheeted trenches. The smallest buckets available are about 1 yd. capacity.

In one type of trenching machine the bucket is raised to and carried by a trolley running on a rail supported above the center of the trench, by which it is run back and dumped directly onto the completed sewer.

19. Safety Factors.—Where the WPA has done trenching work, its practices and policies in regard to safety should be well known, since that organization has contributed a great deal to the practical application of measures to prevent accidents to workmen. Among the elements to be considered are piling dirt excavated from trenches; sheeting of trenches; control over explosives and their storage and use; inspection and care of equipment to insure it is in safe working condition; protection of openings; protection of workmen from traffic; and similar factors. In actual construction, it is necessary to enforce these measures rigidly, by discharge of workmen for neglecting them if necessary. The attitude of the foreman is perhaps most important of all; if he is not interested in safety, the record of accidents is likely to be unfavorable.

20. Piling Dirt.—Many accidents occur in trenching due to carelessness in piling the dirt along the side of the trench. A space of at least 2 feet should be kept clear between the edge of the trench and the toe of the slope of the excavated material. Doing this (a) provides a pathway along the edge of the trench; (b) reduces the number of accidents caused by stones, clods of dirt or pieces of lumber or tools falling back into the trench; and (c) greatly reduces the tendency of the trench to cave. Many accidents, and often the more serious ones, are caused by the caving in of the trench on men working in it. By piling all dirt well back from the edge of the trench, the weight at this critical point and therefore the likelihood of caving are reduced. Stones that are liable to roll down the piled-up material and fall into the trench should be placed elsewhere.

While choice of the side on which dirt is piled is usually dictated by such considerations as laying the pipe, the pile may sometimes be so placed as to divert storm water. In every case, arrangements should be made to prevent, so far as is possible, storm water from running into the trench.

21. Sheeting.—When the depth of the trench exceeds 4 or 5 feet, some bracing or sheeting may be needed to prevent caving. In hard clay, even deeper trenches may stand indefinitely, but in sandy, wet, or loose soils, bracing may be needed for safety to the workmen and to prevent rehandling of caved material in trenches only 3 or 4 feet deep. In considering the need for sheeting or bracing, the length of time the trench will be kept open is highly important. In many cases, a trench can be left unbraced for a few hours which would cave in if left for several days. In addition to the time element, the tendency to cave is hastened by rain, by vibrations from passing vehicles—an important factor in most trenches

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New Incinerator and Steam Plant, City of Atlanta, Georgia.

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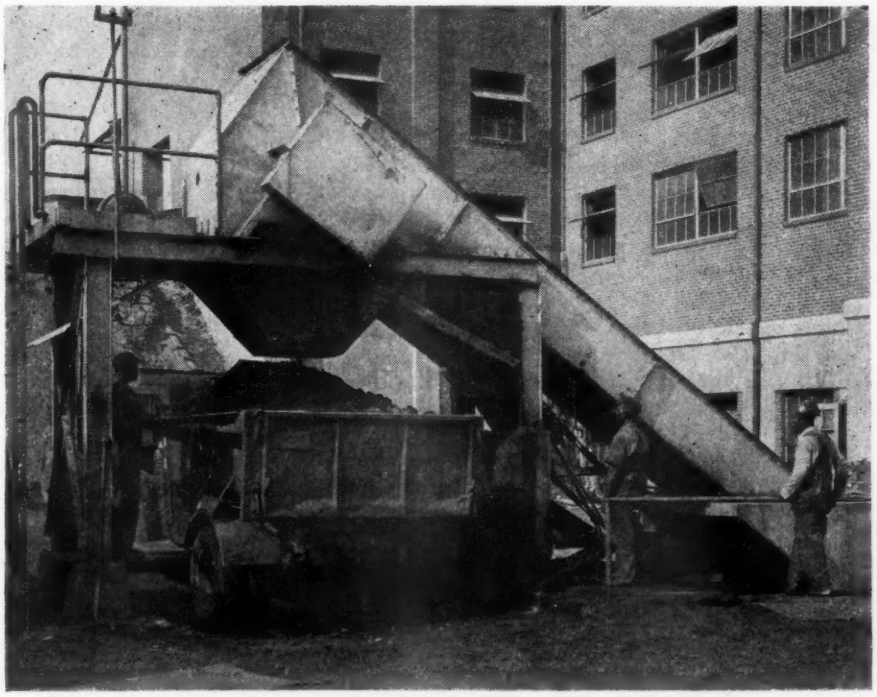

View from west side, showing Beaumont Birch Corp. ash conveyor.

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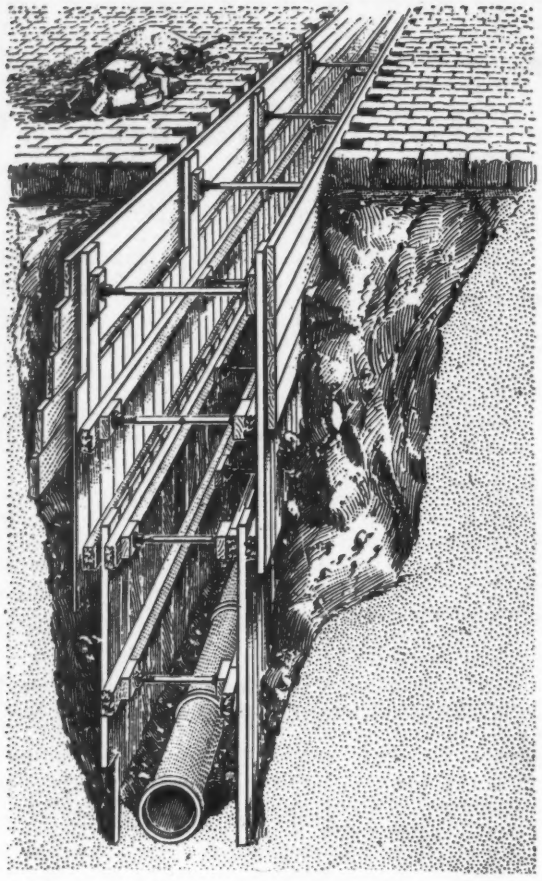


Sheet piling in a deep trench with extensible iron braces. Box or horizontal sheeting at the top.

constructed along or in roads or streets—and by blasting, or even the use of air hammers for drilling. Piling dirt too near the edge of the trench is a common cause of caving.

Since it is impossible for a man who is not experienced in trench work to judge the necessity for bracing, and since a degree of risk always exists that serious injury will occur to the men working in a trench more than 5 feet deep if caving occurs, no chances should be taken. It is better to spend, even though unnecessarily, the time and money necessary for sheeting in order to safeguard the men.

In contract work, the decision to sheet or brace the trench is largely a responsibility of the contractor, but both the municipality and the engineer share that responsibility as regards the safety of the workmen and should therefore insist on proper measures when these appear necessary. Except as regards appreciable delays to the work, the municipality and the engineer have no responsibility for factors other than safety of the workmen.

22. Sheet Piling.—*Sheet piling,* or simply *sheeting,* is the term used to describe the temporary framing by which the sides of the trench are prevented from caving. Two-inch plank has generally been used for sheeting, but in late years there has been a greatly increased use of light corrugated iron sheet piling for this purpose. This sheeting is easy to drive and can be pulled and reused many times. Where timber is used, 1-inch material can be used for shallow trenches, but 2-inch is generally better as it can be reused 2 or 3 times. The piling should generally be 6 to 8 feet long, two or more stages being used for deeper trenches; longer pieces can be used, but are difficult to drive by hand.

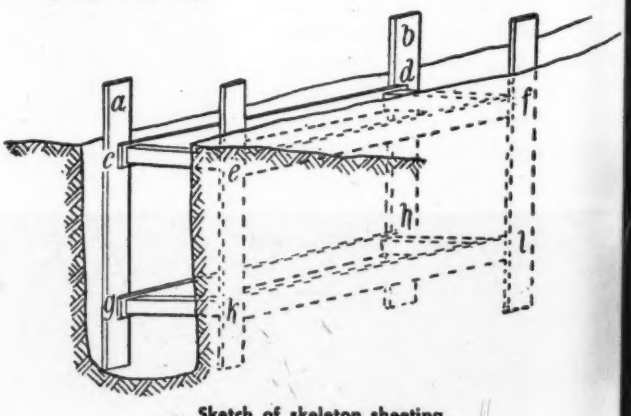
The usual procedure is to place rangers about 4″ x 6″ and as long as desired alongside of and on both sides of the trench; the sheeting is then driven down between the ground and the rangers, which are cross-braced at frequent intervals. Excavation follows closely, or may precede slightly the driving of the sheeting, except in very soft or running soil, where the bottom of the sheeting should be kept several inches below the excavation. When the sheeting follows or only slightly precedes excavation, the piles are chisel-edged, with the bevel on the trench side; when driven ahead of excavation, sheeting is given a double bevel. Many contractors use, instead of wooden braces, extensible iron ones, which can be adjusted quickly to any length and used over and over again.

In most cases the planks are driven to form a solid and continuous line of sheeting. Additional rangers are placed at intervals of about 4 ft. depth. Cross-braces or shores are cleated at the top to prevent falling out, and nailed to the rangers. When additional stages are necessary, as when the depth of the trench to be sheeted is more than about 8 feet, the second stage of sheeting is driven inside the rangers of the first stage, and additional width of trench is necessary to allow for this.

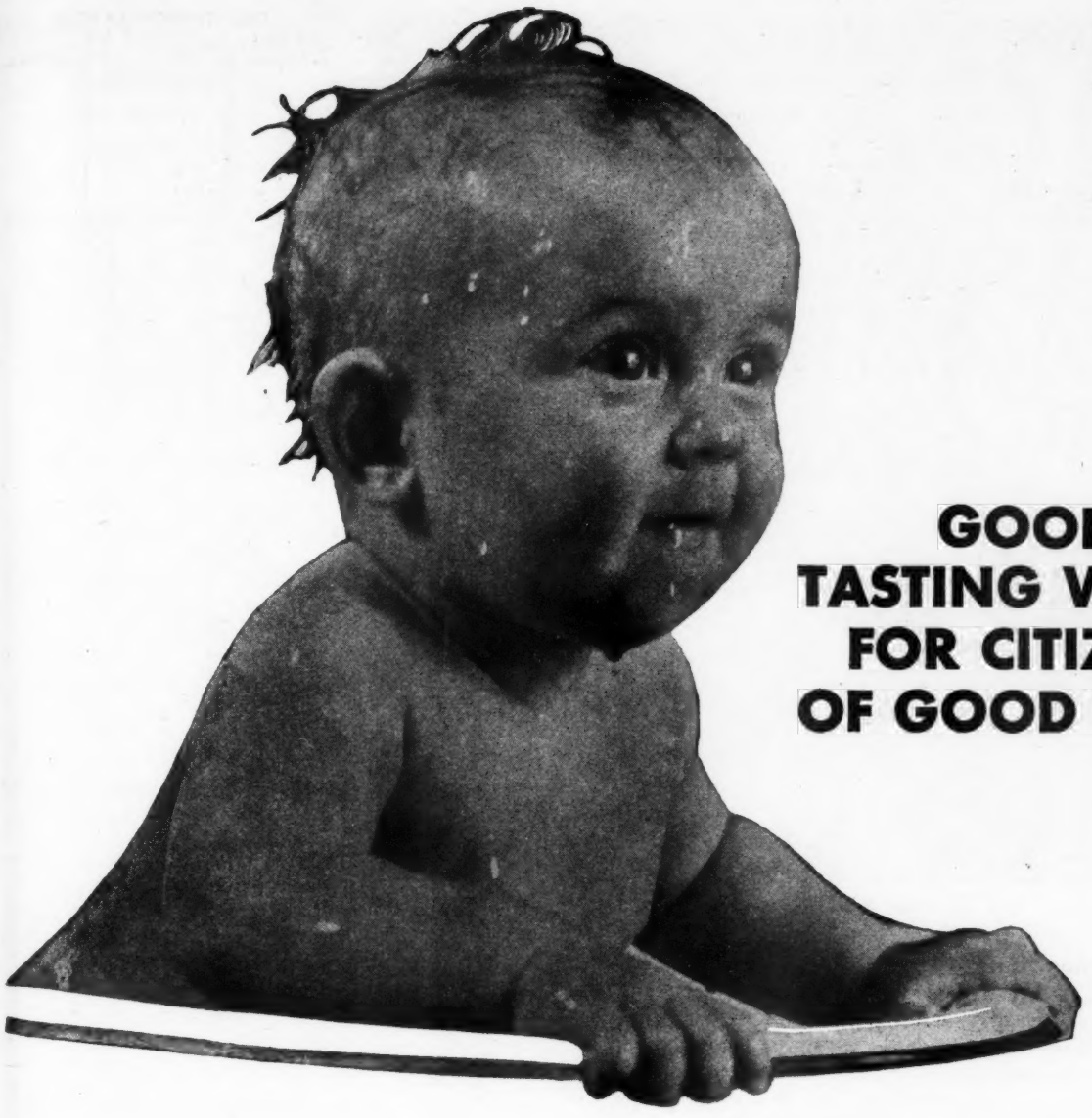
23. If 2-inch plank and 4-inch rangers are used, the trench will be about 6 inches wider on each side than would be necessary without sheeting. If another set of sheeting and rangers are then placed inside the first set, allowance must be made for this when the original excavation is started. Assuming an 18-inch pipe, and a trench 14 feet deep, the trench width without allowance for sheeting would be 30 ins.; and assuming it is desired to have this space clear at the bottom of the trench (which is usually desirable), the width of the outside of the lower stage of sheeting would be 42 ins., and of the upper stage 54 inches. The out-to out measurement of the first stage rangers will then be 50 ins. and cross-braces will be 42 ins. long.

The rangers and cross-braces are used to support the staging platforms for rehandling the dirt, already mentioned as necessary in deep trench work. These extend half-way across the trench and can also be used for the men to stand on in the first stages of driving the lower set of sheeting. Special care should be taken to see that rangers and braces which support staging platforms are secure against falling under the weight so imposed on them.

Air or gas hammers are desirable for driving sheeting, though wooden mauls or sledges are often used. When 6-ft. or 8-ft. sheeting is first started, a platform may be necessary on which the men stand while driving the sheeting.



Sketch of skeleton sheeting.



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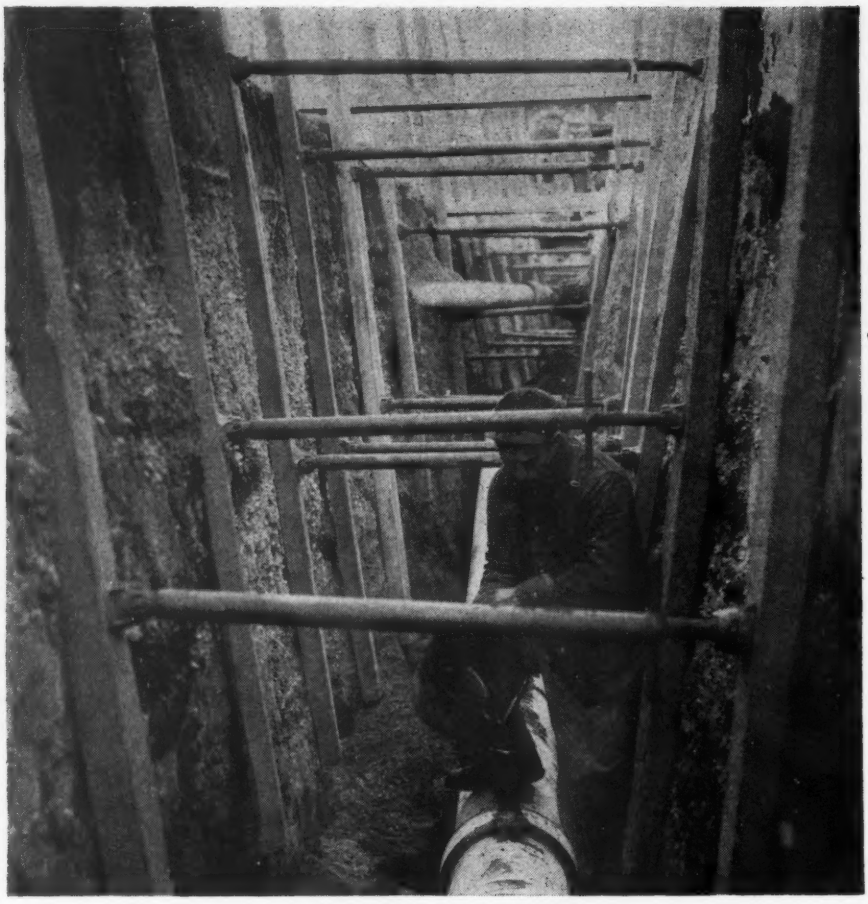
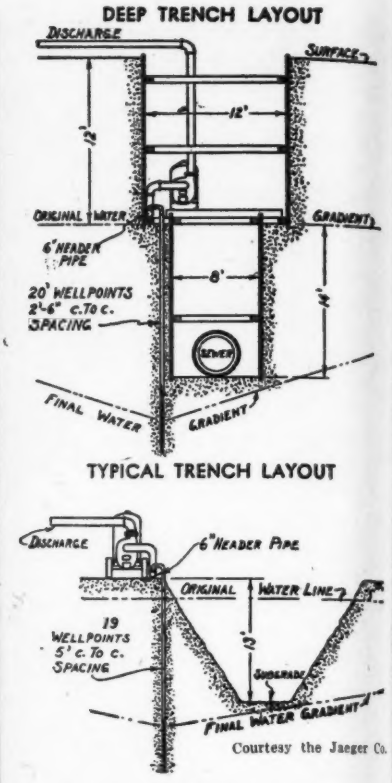


Stay bracing in a deep trench.



Typical layouts of wellpoint drainage of trenches.

24. Other Kinds of Sheeting.—*Skeleton sheeting* consists of the usual arrangement of rangers and cross-braces already described, but with sheeting planks at intervals of 3 or 4 feet only. Intermediate sheeting planks may be added later if desired to form more or less complete sheeting. *Stay bracing* consists of sheeting planks placed at necessary intervals, in pairs, with cross-braces between them, but without rangers. Such stays are frequently placed at intervals of 6 to 10 feet; they should be used for temporary supports only, for not more than one day or, at the most, two days. Stay bracing should not be used where complete sheeting is needed. *Box sheeting* consists of planks placed horizontally on edge. The most frequent use of box sheeting is to increase by 3 or 4 feet the depth that can be reached with a single stage of sheeting. For instance, if piling is cut 8 feet long, and the trench depth must be 11 feet, box sheeting might be used for the upper 3 feet. Also, the use of the box sheeting may eliminate the need for a platform from which to drive the sheeting. The trench is dug to a depth of 3 or 4 feet, about 8 inches wider than is required for the sheeting and the rangers. Stakes are driven down to support the box sheeting and the sheet piling and rangers are then placed and driven from the bottom of the box-sheeting.

25. Draining the Trench.—If the bottom of the trench is wet and muddy, the men cannot work efficiently, the pipe cannot be laid on a firm foundation and true to line and grade, and good joints are difficult or impossible to obtain. According to local conditions, drainage can be accomplished in any of several ways.

a. By direct drainage, by keeping the bottom of the trench at a uniform slope from the completed depth to the forward end. This is not usually very satisfactory because there is always water in the trench (even though it is flowing out), and the bottom of the trench is always muddy. Also, as the water or sewer line is completed and backfilled, this method is of no value, unless the pipe line is used to drain off the water, which is not always desirable.

b. By means of an underdrain in the trench. A trench a foot or so wide is dug 12 or 15 inches deeper than grade, and an open-joint drain tile is laid in a fill of gravel or broken stone. If possible, this should discharge to a watercourse, but if none is available it may be discharged to a sump, from which the water is pumped. Such an underdrain is left in place after construction. If it can discharge to a natural outlet, this is especially advantageous. Such drains offer the best means of draining the trench; their use prevents the accumulation of water with consequent seepage into the banks and bottom during the night when pumps are not working. Drains may be of corrugated perforated pipe or of extra heavy drain tile if they are to function permanently. If for temporary use only, agricultural drain tile may be used. However, these crush easily and in breaking may permit the pipe over them to sag or break. For most work 4-inch pipe is large enough. In some cases, the drains instead of being directly beneath the pipe are offset to one side.

c. Pumps may be used to remove the water, the water being best collected in a sump, from which the pump or pumps can operate effectively. The pump is moved ahead 25 ft. or so when pipe laying reaches it. If the water does not contain much sand or muck, a gasoline driven centrifugal pump is excellent. On most small jobs one or two 2-inch portable units will be sufficient (every village or city should own sev-

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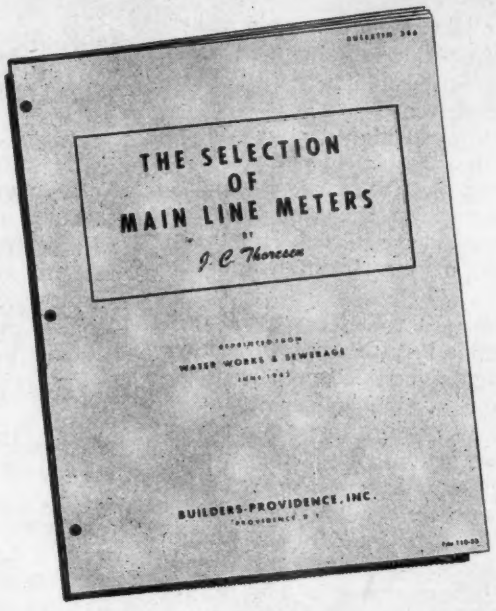

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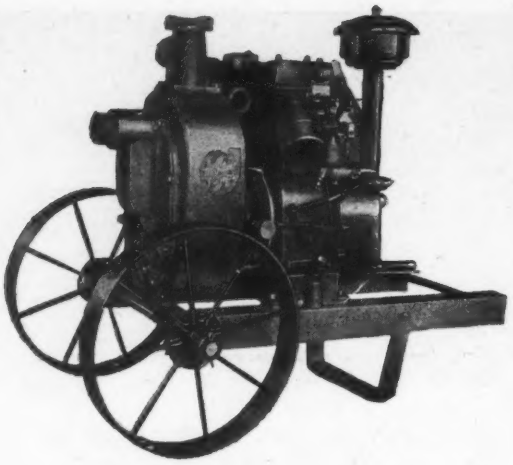


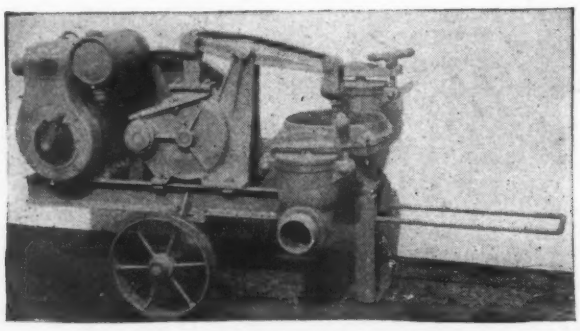
Marlow 3" self-priming trench pump.

eral of these). On larger jobs, more or larger pumps will be needed. Where the water contains mud, sand and grit, a diaphragm pump should be used. These, also, are gasoline engine driven.

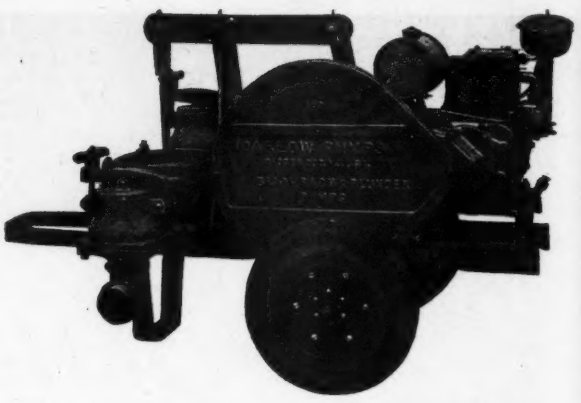
If the pumps are not run all night, water collects in the trench, and soaks into the bottom and sides. In the morning, the bottom of the trench may be muddy and water may continue to seep from the sidewalls for some time after the pumps have started. It is therefore desirable to keep the pumps operating night and day.

26. Rock Excavation.—It is better to avoid rock excavation whenever possible because costs are always very high when trenching in rock. When it is necessary to cut a trench through rock, an expert on the use of explosives should be consulted and his advice followed in regard to size, depth and spacing of drill holes. Air hammers or gasoline hammers are used for drilling. Air compressors are available in a wide variety of sizes, from small 18 cu. ft. per minute sizes up to very large units. Most communities will find a 60-ft. or an 85-ft. compressor a most useful tool for many uses, such as cutting pavement, drilling, driving piling, tamping, etc.; a gasoline hammer is highly portable and will do most of the jobs that an air hammer will do.

Rock should generally be removed to a depth of 6 inches below the pipe line grade, and the trench refilled to grade with selected dirt. The trench should usually be cleared to the same width as though it were cut in dirt. Since the rock breaks unevenly and beyond the desired limit of excavation, considerably more yardage will be removed than in the case of dirt. On contract work, this extra yardage is not usually paid for but removal of all rock protruding into the trench may not be required. The principal objectives are to keep the completed pipe well clear



Carter "Humdinger" portable trench pump.



Marlow 4" single "Mud Hog," showing enclosed gearing.

of rock, and to have the trench wide enough so that a good job of pipe-laying can be and is performed. After the initial cover of 2 feet of selected and carefully placed earth, the broken rock can be used for backfill if well mixed with earth. If not so mixed, the earth above will continue to work down into it and the trench surface to settle for months or even years after the completion of the job.

27. Tunneling for Pipe Lines.—When cuts exceed a depth dependent on local conditions, tunneling will be cheaper. It may also be desirable for other reasons, as non-interference with traffic or with subsurface structures. Such tunnels may be several blocks long, or may be comparatively short, as to pass under a street intersection, under railway tracks, etc.

Long tunnels should be undertaken only under the direct, or at least advisory, control of someone familiar with that class of work. Shorter tunnels in solid soil may often be excavated without lining; but the roof should always be supported, no matter how solid it may appear. For this, 2" plank may be used for the roof, 4 ft. to 6 ft. long and running lengthwise of the trench, supported by cross pieces of 4" x 4" or 4" x 6", which in turn are supported by a post at each end and resting on a piece of 4" x 6" x 12" on the earth bottom.

For lengths up to 150 ft. or more, in favorable soil, pipe up to 36" diameter can be laid by means of boring or pushing machines. For small pipe, a "tunneling scoop" to be screwed onto the end of ¾" pipe can be used by hand for driving a tunnel up to 10 or 12 ft. long. A motor-driven machine can be obtained for drilling horizontal holes up to 12" for distances up to 80 ft. Pipe up to 4" can be pushed without tunneling for a distance of 50 to 150 ft. (depending on nature of soil), a steel pilot being fastened on the front end of the pipe, by means of a pipe pusher, several makes of which are available, some using levers and racks, others hydraulic power. One machine bores a hole for pipe 2½" to 14½", using a compressed air motor to drive an auger.

28. Bedding and Foundations.—When sewers are to be laid, special attention must be given to shaping the earth in the bottom of the trench so that the lower 1/3 of the sewer pipe will be in uniform contact with the soil. Bedding of water pipe is discussed in Par. 57. In either case, if rock is found in the bottom of the trench, this should be excavated at least 4 inches below the bottom of the pipe and a bed of sand or dirt placed between the rock and the pipe.

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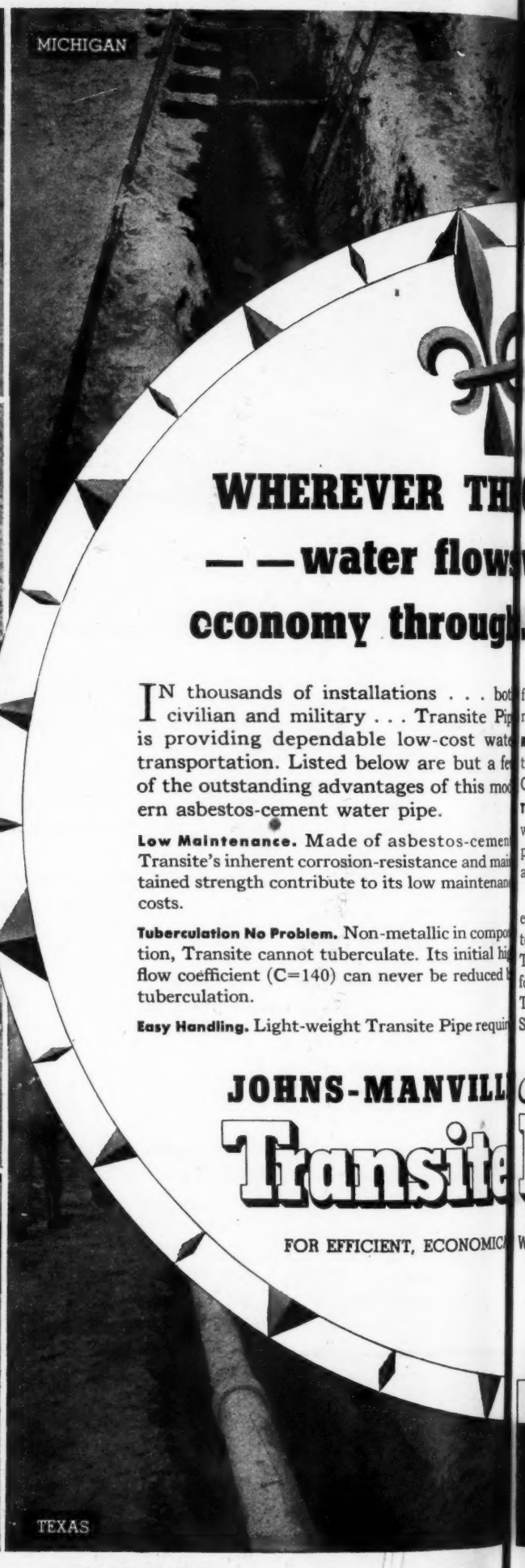

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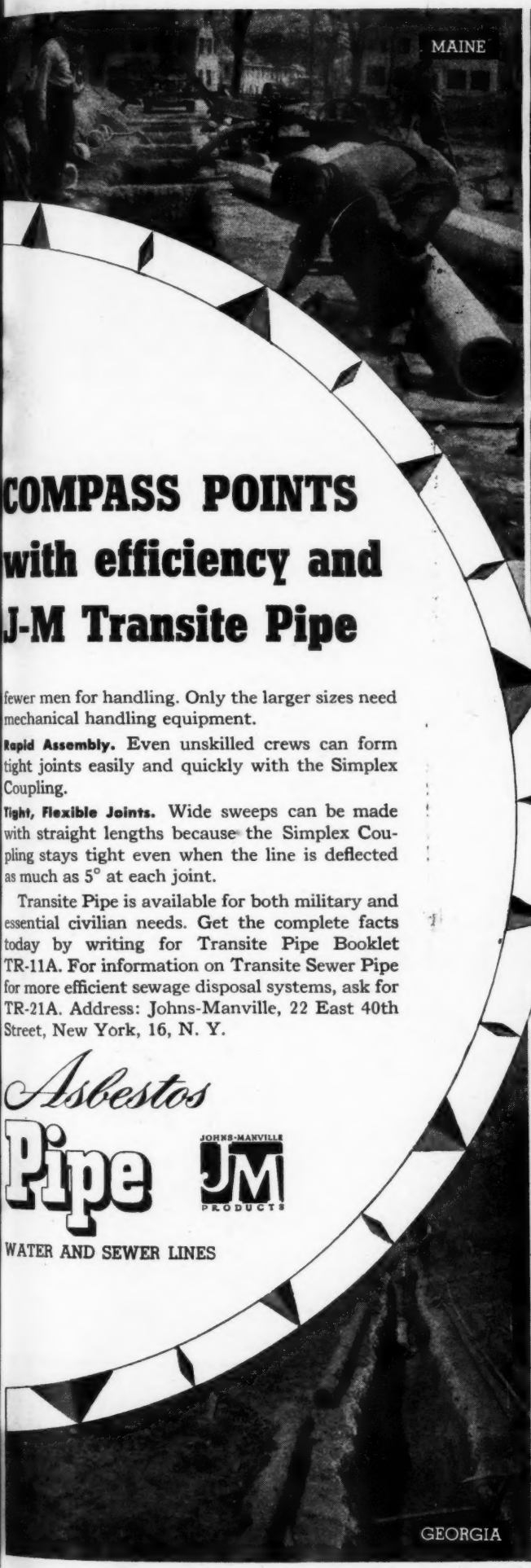

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WATER AND SEWER LINES

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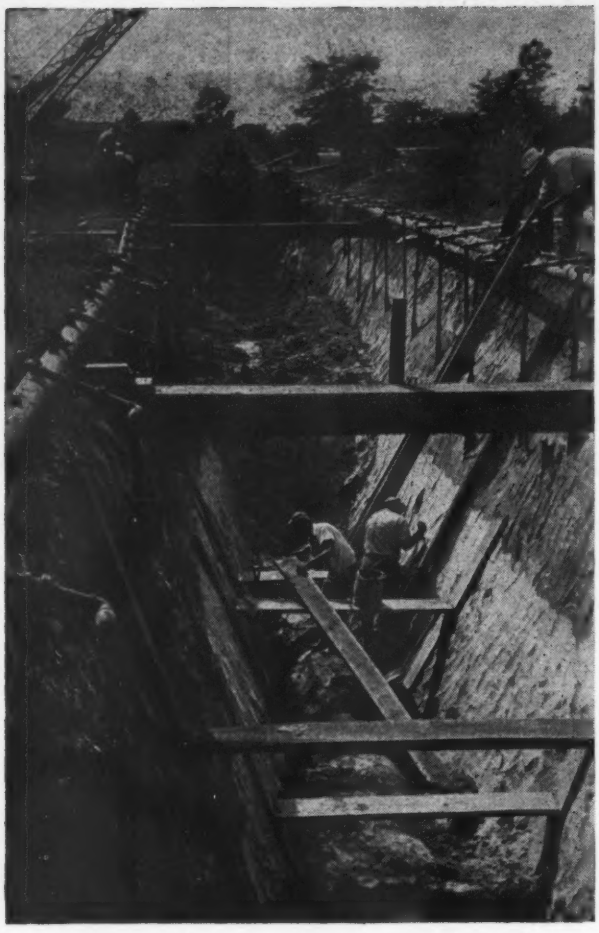

Excavating for a deep sewer, using well points.

firm. Where the soil is soft, a foundation or support is needed. Stabilization by the removal of 4 to 6 inches of soft soil and its replacement with fine gravel or other granular material may be sufficient. In other areas, concrete may be deposited in the bottom of the trench. If placed after the pipe has been laid, care should be taken that the pipe is not lifted above grade by the concrete. The purpose of the concrete is to form a continuous bearing and a firm support for the pipe.

In some places where the ground is too soft to support the pipe, stakes or piles may be driven into the bottom of the trench and longitudinal beams set at proper grade be fastened to the piles or stakes, with frequent cross timbers to support the pipe. The size of the longitudinal beams depends upon the size of the sewer, the character and uniformity of bearing power of the soil and the amount of cover over the pipe. Unduly small timbers are useless; ordinarily they should be approximately 4" by 6".

29. Laying the Pipe. Testing.—These subjects will be discussed in greater detail in Sections III and IV, which are devoted to good practices in laying of sewers and laying of water pipes, respectively. As already stated, clearly written specifications or directives should be prepared covering these important steps in construction. Moreover, through careful inspection and supervision, compliance with the specifications and directives should be assured.

Work that is to be placed underground and is expected to operate for years without maintenance, attention or repairs justifies the use of the best materials and the best methods. Anything else represents very shortsighted procedure and is never justifiable. Sewers and water mains are normally intended to serve for 30 to 50 or more years. They will not do so unless properly constructed. The practices outlined in Pars 43, 44, 50, 51, 57 and 65 should be followed.

30. Backfilling and Compacting.—As soon as the pipe line has been completed and tested, it should be backfilled. This is especially true of sewers, where exact grades are especially important, because in some unstable soils the bottom of the trench may heave slightly. For backfilling around the pipe and to a depth of about 2 feet over it, only well selected material, free from stones and large hard lumps should be used. Further details of backfilling will be given separately for sewer and water pipe, since special procedures should normally be followed for each.

After the pipe has been covered to a depth of about 2 feet with selected material, the remainder of the trench is backfilled. In open country, care in placing this backfill is not so important; when the trench is in a street or alongside a road, skill and care should be exercised so that the fill will bear the loads of traffic without settling. The fill should be added in layers of 6 to 12 inches and rammed; an air or gasoline hammer equipped with a tamper is usually the best device available for tamping. Where the fill is of sand or gravel, it may be consolidated by puddling or flooding it with water, which is added as the trench is being filled or after it has been completely filled with dirt. With clay, puddling forms a mud which may not become firm for a long period and is thus unable to support any surfacing. Too much water should not be used—only enough to permit the material to compact as the water drains out. In the case of sewers in trenches over 10 or 12 feet deep, compaction by flooding may add so much to the loading as to cause failure of the pipe. In fact, an 18-inch sewer poorly bedded, and in a trench 10 ft. deep and a little too wide would probably crush under the load of very wet sand.

Fuller information on safe loads on sewers will be given in Part III, Laying Sewers. In general such information does not apply to water mains except when a thin steel pipe is used. In the case of sewers in deep trenches, particular attention should be given to bedding the pipe and to the width of trench.

31. Paving the Cut.—The actual paving of the trench opening in a street or road is often or usually done by the street or highway department. In any case, an essential preliminary is that the trench backfill be properly compacted. Traffic is probably the best means of accomplishing this. Therefore, the opening should be brought up flush with the street surface or slightly above it. After traffic has passed over the trench sufficiently so that no further settlement can be expected to take place, paving is accomplished as follows. The trench is cleaned out to a depth somewhat greater than the thickness of the pavement, including the base, and undercut beneath the base of the undisturbed pavement on both sides. If a bituminous pavement, the edges of the cut are painted with tar or asphalt, and the hole filled preferably with a cold mixture of aggregate and either tar or asphalt, similar to that used in the original surfacing. This is compacted flush with the surface. If the street is of reinforced concrete, undercutting should be more pronounced, reinforcement in the pavement should be tied in with new reinforcing, and the hole filled with a rather dry concrete mix tamped in place. (See PUBLIC WORKS for May, July and August, 1942, for more detailed information on street patching practices.)

32. Protecting Traffic.—No openings that can be reached by traffic should be left without a barricade or other adequate protection, including red lanterns or

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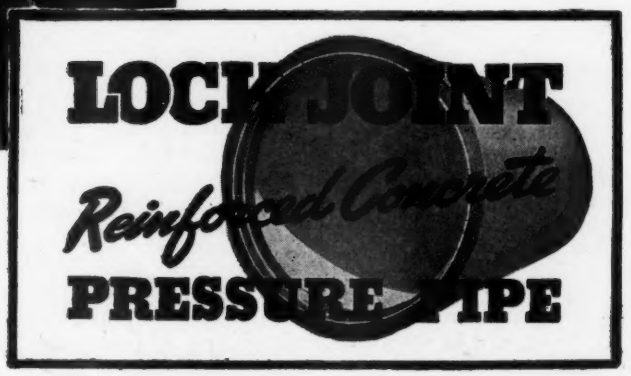
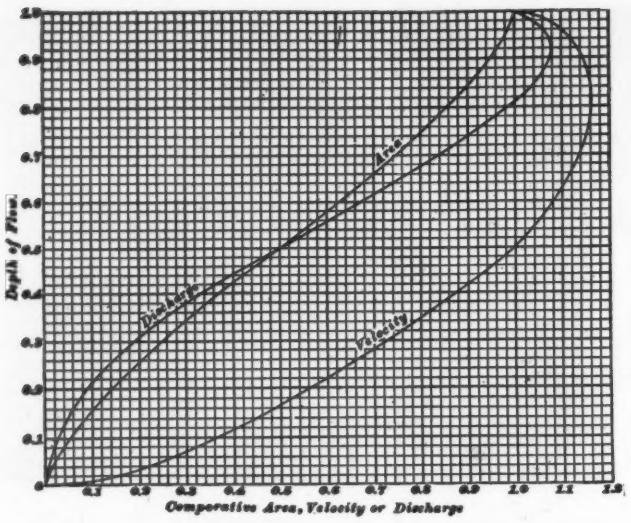




Relative area of sewage, velocity and discharge at different depths of sewage expressed as fractions of the diameter.

torches at night. Except in unusual places, barricades need not be heavy enough to deflect traffic, but they should be highly visible day or night, resistant to blowing down, and durable. There are a number of manufactured supports which fulfill these requirements admirably and are much better than homemade ones.

Torches and flares should be such as will remain lighted through the strongest wind and the heaviest rain, should have the capacity to burn for at least 24 hours, and should be stable to resist overturning. Lanterns should have the same general characteristics.

On open roads, a warning sign should be set about 300 yards in advance of the work; in streets, warning signs should be placed at every block. In addition to this, there should be a continuous barricade between that portion of the street left open to traffic and any excavation. If the trench is near a sidewalk, a continuous barricade should be placed between the trench and the walk. Warning signs should be designed for the worst conditions on a dark and rainy night and not solely for good or average conditions.

One man should be responsible for seeing that all barricades are placed properly before leaving the job at the close of work in the evening; he should also be responsible that all warning lights are lit. The necessity for a night watchman depends on local conditions.

33. Care of Tools.—Tools should be kept sharp and in good condition and should be checked in and out to prevent loss. Picks and drills rapidly become dull in hard ground, greatly reducing the efficiency of the workmen. Shovel and pick handles break. Adequate provision should be made for sharpening and rehandling tools. On a small job arrangements can be made with a local blacksmith, and a pick-up truck should make regular trips to keep the tools in condition and in use. On a larger job, especially one some distance from a blacksmith shop, a portable shop may be set up.

Protection of tools against theft is best accomplished by having a good tool box in which all tools are securely locked at night. These can be home made, but several manufacturers furnish very handy, convenient and safe boxes.

When there is one gang only at work, the foreman can be charged with the tools and be made responsible for them. When there are 2 or 3 gangs, one man should be responsible for issuing each morning to each gang foreman the predetermined necessary number of tools, a record being kept of the number and kind and those returned at night checked against this.

III. Laying Sewers

34. Kinds of Sewers: Volume of Sewage.—*Storm sewers* are used to carry off storm water, water from melting snow, and ground water. *Sanitary sewers* carry the sewage from residences, office buildings and factories. This text refers principally to sanitary sewers, though certain data in regard to methods of laying pipes, trenching, etc., apply also to storm sewers. Data as to depth, velocity of flow, slope, location, and manhole construction generally refer only to sanitary sewers.

The amount of sanitary sewage to be expected will be about 100 gallons per person per day. Estimate what the population will be when the area to be served is built up. Make allowances for ground water flow (about 1,000 gallons per acre per day). If the sewer lies in ground water, increase this allowance, computing it on the basis of the area served by the sewer. Care in construction of the sewer to make it as tight as possible is of special value in reducing infiltration. The total required capacity of the sewer may be based on a flow 2½ to 4 times as great as the average flow arrived at by the above calculation. This provides for periods of peak flows, unexpected volumes of infiltration and otherwise provides a safety factor.

35. Size of Sewers.—Sewers less than 8 inches in size should not normally be laid except for house connections though 6-inch pipes are permissible for short lines with good grades. Sewers are generally designed so as to provide enough capacity to care for expected flows 40 or 50 years in the future. Since housing conditions may change a great deal in any area during that time, a good deal of guesswork may be involved for any but main sewers or submains. For ordinary conditions, 8-inch lines will handle up to about 400,000 gallons flow per day with a slope of 4 feet in 1000, which is about as flat as sewers should be laid except in cases of extreme necessity.

Discharges for 8, 10 and 12 inch sewers laid on various grades, assuming good workmanship in laying and good pipe, are

	Gallons per minute			*Gallons per day*		
Slope	8″	10″	12″	8″	10″	12″
3 feet in 1000	270	503	830	388,000	724,000	1,200,000
4 feet in 1000	310	574	955	443,000	820,000	1,364,000
5 feet in 1000	350	646	1085	500,000	920,000	1,550,000

The slope of the sewer necessary to maintain a velocity of flow sufficient to prevent depositing of solids in the sewer depends on the size of the pipe. It has been found that if sewers are laid on such a slope that, when flowing half full, they will have a velocity of not less than 2 feet per second, such deposits will not normally occur. Slopes for 8, 10 and 12-inch sewer to provide 2 feet per second velocity in carefully laid lines are

Fall Feet per 100′
8-inch.....0.33 to 0.40
10-inch.....0.25 to 0.28
12-inch.....0.19 to 0.22

36. Depth of Sewers.—Sewers must usually be placed deep enough to be reached by gravity flow from all but exceptionally deep basements. However, when a sewer is extended from an existing sewer or manhole, its elevation is fixed by the connection at the manhole. Normally, in most small communities, a depth of 6 to 10 feet will be enough to serve all

basements. In the south, where relatively few of the buildings in the residential areas have basements with plumbing fixtures in them, sewers may be placed much nearer the ground surface—sometimes only 3 or 4 feet deep. Because costs increase very rapidly as the depth increases in excess of about 6 ft., advantage should be taken of every possibility to avoid excessive depth.

A careful engineering survey may determine a location where the savings in excavation due to lesser depths at which the pipe must be placed will more than pay for the survey.

37. Special Problems in Construction.—Particular attention should be given to all locations where sewers are placed close to water mains. If the water pipe is dug up for repairs, and a nearby sewer breaks, has broken, or overflows, there is considerable danger of contamination entering the water pipe. For this reason, sewer and water pipes should never be laid in the same trench. Because a broken water main may break away the dirt supporting a nearby sewer and cause it to break, it is desirable to use a cast iron pipe for any section of a sewer within 6 to 10 feet of a water main, particularly if the sewer is at a higher elevation than the water pipe.

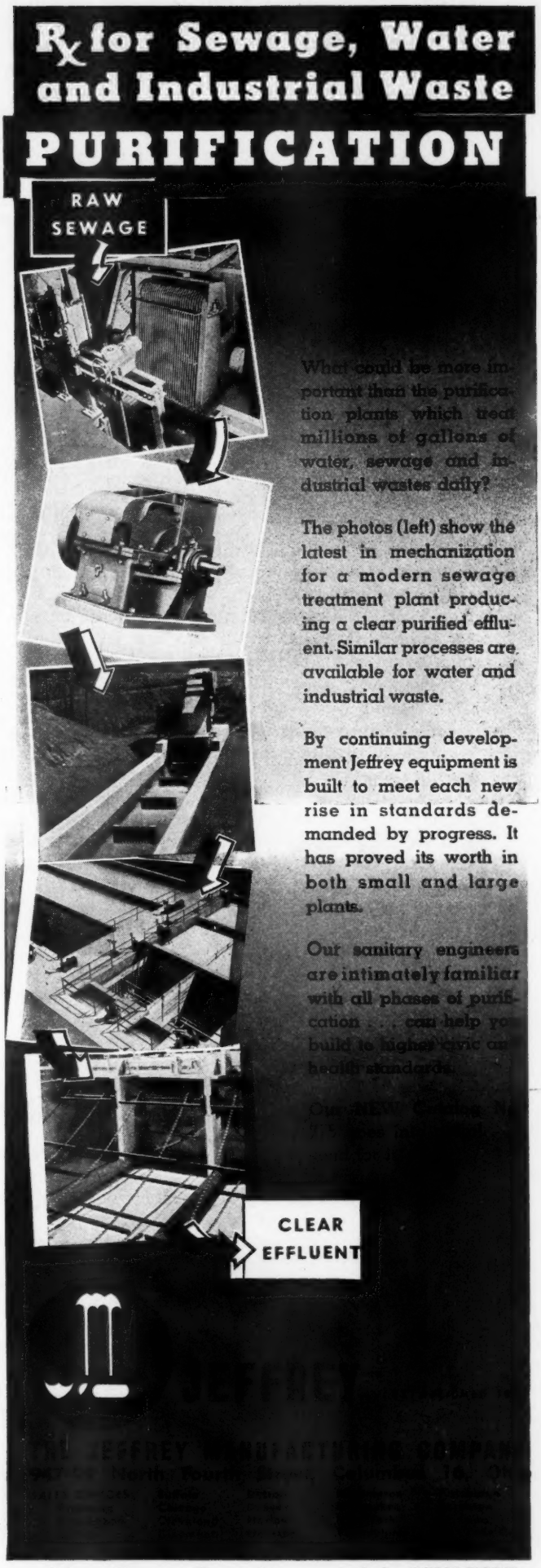
When a sewer is laid in fill or in soft or "made" ground, special attention should be given to supporting it properly. If the ground under the sewer settles, the sewer also may settle and break, or solids will build up in the low place and clog the line.

Where the sewer is exposed to excessive vibration, as from heavy traffic or a near-by railroad, some protection may be desirable. In some instances, as where connections are not necessary, steel pipe may be used; or in places where vibration is serious, house connections may be made at manholes and steel pipe used between manholes.

38. Loads on Sewers.—Tile and concrete pipe sewers may fail due to crushing by the weight of the fill over them when placed in deep trenches, unless proper construction practices are followed. The load on the sewer pipe is greatly influenced by the width of the trench at about 1/6 the diameter of the pipe down from its top; that is, in a 24-inch pipe, about 4 inches below the top of the pipe. The supporting strength of the pipe is greatly influenced by the manner in which it is bedded in the trench. The three usual methods of bedding are called *ordinary*, shown in Fig. O[1]; *first-class*, shown in Fig. F[1]; and *concrete-cradle*, shown in Fig. CC. In *ordinary bedding*, the pipe must be bedded with some care in the bottom of the trench, which must be shaped to fit the lower 10% of the overall height of the pipe. Also, backfill of granular material thoroughly tamped in place must be placed around the pipe and to a depth of at least 6 ins. above its top.

For *first-class bedding*, the pipe must be carefully placed on a fine granular material in the bottom of the trench, which is so shaped as to fit the lower part of the pipe for at least 60% of the pipe width. Also backfill of granular material must be placed by hand in 6-inch layers and tamped, the fill being carried in this manner to at least 12 ins. above the top of the pipe.

In *concrete bedding*, the pipe is bedded in concrete which has a minimum thickness below the pipe of ¼ the pipe diameter, and which extends up the sides of the pipes for a vertical distance not less than ¼ its outside diameter.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39. The supporting strength of pipe laid in first class bedding is about 1¼ times as great as when laid in ordinary bedding. When laid in concrete bedding, the supporting strength is 1½ to 2½ times as great as for ordinary bedding. When pipe is laid carelessly, it may have much less supporting strength than with ordinary bedding.

The trench width near the top of the pipe should not exceed 1½ times the outside diameter of the pipe, or the load on the pipe will be greatly increased. The ratio of the depth of the fill above the pipe to the width of the trench at the top of the pipe is important. Approximate loadings, in pounds per foot of length, on pipe in trenches of various depths and width are as follows:

Width of Trench at Top of Pipe and Type of Soil Cover

Depth of Trench in Feet	*Loading in Pounds Damp clay, 100 lbs. per c.f. Trench width*				*Loading in Pounds Damp sand, 110 lbs. per c.f Trench width*			
	2	3	3½	4	2	3	3½	4
6	830	1400	1680	2000	880	1500	1800	2130
7½	950	1650	1960	2400	1000	1750	2100	2520
9	1050	1870	2300	2720	1100	2000	2450	2890
10½	1130	2050	2550	3000	1200	2180	2700	3220
12	1200	2220	2750	3325	1240	2350	3020	3520
15	1300	2500	3130	3800	1330	2600	3450	3980

Particular attention is directed to the very marked increase in loading resulting from increasing the trench width from 2 ft. to 3 feet. The width of the trench at the top of the pipe is the most important factor. Saturated clay will produce a heavier load than damp sand, and may be figured at 120 pounds per cubic foot. This will increase loadings about 10% over that for damp sand.

40. Strength of Pipe.—A minimum crushing strength is required for clay sewer pipe by ASTM specifications, using the three-edge-bearing method. However, the strength by the three-edge-bearing method does not represent conditions in the trench, and for the purposes of this article, the figures shown below can be taken as the permissible trench loading, including a fair safety factor. No allowances for impact or for loads superimposed on the trench are made.

Size of pipe	*Ordinary Bedding*	*First Class Bedding*	*Concrete Bedding*
8	1000	1240	2000
10	1100	1370	2200
12	1200	1500	2400
15	1370	1725	2740
18	1540	1920	3080
21	1810	2250	3620
24	2150	2680	4030
30	2580	3210	5160
36	3080	3840	6160

The values for concrete bedding are conservative, and loadings heavier than those given are usually safe if the bedding is well placed and well constructed.

The necessity for keeping trench width, especially at the level of the top of the pipe, to the minimum previously given in this text—about 8 inches plus the diameter of the pipe for pipe smaller than 12-inch, and 1 2/3 of the pipe diameter for larger pipe—is clearly evident. Thus, a 21-inch sewer requires a 35-inch wide trench, and a 15-inch sewer a 25-inch trench.

41. Examples.—(1) A 15-inch sewer must be placed in a trench 12 feet deep, with a covering of damp or wet sand. What kind of bedding will be required for safety?

SOLUTION: The trench for a 15-in. sewer should not be wider than 25 ins. at the top of the pipe. Using the figures for 2-ft. wide trench given in the Table of Art. 39, the loading for damp sand is shown to be 1240 pounds per lineal foot of pipe. According to the Table of Art. 40, a 15-inch pipe with ordinary bedding, without allowance for impact, will be safe under a loading of 1370 pounds. Therefore, ordinary bedding can be used but first class bedding would be better.

(2) A 24-inch sewer is to be laid in damp clay in a trench 10½ feet deep. In order to permit the use of sheeting, the trench is made 4 feet wide. What is the load on the pipe?

SOLUTION: From the table of Art. 39, the loading on the pipe in a trench 4 ft. wide will be 3000 pounds per lineal foot. By reference to Table, Art. 40, it will be seen that concrete bedding will be required to prevent failure of the pipe if the trench is to be 4 feet wide. It might be possible to narrow the bottom 2 ft. of the trench to no more than 3½ feet, stopping the sheeting at this depth, which would reduce the loading to 2550 pounds per foot, and use first class bedding.

As already stated, there is a factor of safety in the figures of Art. 39, but there are also likely to be offsets to the safety margin. Most pipe will support the loadings shown, but an occasional one may be slightly under strength, and it takes only one broken pipe to stop a sewer line.

42. Other Factors.—If sheeting is left in the trench when backfill is placed, the load on the sewer is very considerably increased. Therefore sheeting should always be removed unless a very special reason exists for leaving it in the trench and sufficient protection is given to the pipe to prevent it from crushing.

The necessity for careful bedding of the pipe and for proper backfill, as previously explained, are emphasized by the information just given on pipe loadings. Particular care should be given to all underground structures, such as sewers, which are intended to give many years of service. Costs of repairing careless and improper work are excessive as compared to the cost of proper construction in the first place.

43. Laying the Pipe.—The trench excavation may be made without special care to a depth equal to about the center of the pipe. The remainder of the excavation should be made by hand, by men who have been taught how to shape the bottom of the trench to fit the pipe, to remove stones and rock, etc. Vitrified, concrete and cast-iron pipe usually have bell and spigot joints; transite and steel pipe have sleeve couplings. The former kinds of pipe are laid with the bell end toward the higher part of the line. Because the bell is larger in diameter, a "bell hole" or recess must be dug to receive it. Depending on the size of the pipe, one or more men, or for very large pipe special equipment, will be needed to handle the sections. With smaller pipe, it is often advantageous to make some of the joints outside the trench. Thus, with 8 or 10-inch pipe, 2 or 3 sections can be jointed outside the trench and handled as a single pipe. This practice reduces the number of joints that must be made in the trench where working conditions are often difficult. Proper placing of the backfill around the pipe, and its tamping, should be the work of another gang following as closely as possible after the jointing gang. Where the sewer is to be tested, this should be done before it is backfilled.

44. Jointing.—Joints are probably the weakest part of a sewer under any condition; therefore special

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. . . the earnest men who direct and maintain vital municipal waterworks and sewerage systems have their strategical problems, too. They must conduct their campaigns against fire, flood and epidemics—all enemies of industry and public welfare which would interrupt or slow down manpower and production. They must marshall carefully such supplies as are available. They must shift equipment, make repairs and use to the utmost advantage whatever is obtainable under priority restrictions.

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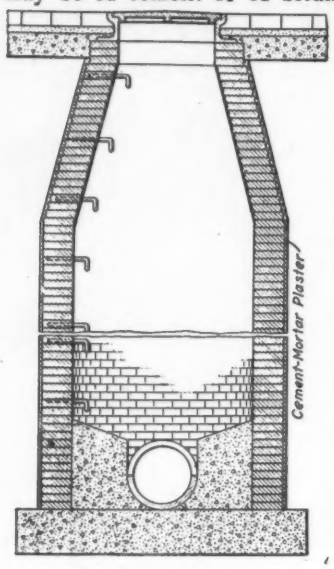
attention should be given them at the time of construction to insure that they are properly made. Joints in the case of pipe having bell-and-spigot joints may be of cement or of bituminous material. Cement joints are not recommended unless the Weston gasket and form or some similar device is used. Poured bituminous joints give excellent results. There are also premolded bituminous joints that are forced into place. Practically all of the bituminous joints are satisfactory when properly used. The directions of the manufacturer of the particular material used should be followed exactly. If this is done, and pains are taken to insure a workmanlike job throughout, good joints will be obtained. Poor joints permit the inflow of ground water into sewers with the result that sewage treatment plants may be overloaded or even flooded; the sewage may back up into basements, and sometimes manholes located in low areas overflow, causing serious nuisance conditions. A little increased expense for good joint material and for its proper use may postpone the expense for renovation or enlargement of the sewage treatment plant, or eliminate the danger of suits against the community for nuisance due to overflowing manholes.



Section of manhole as recommended.

Where cast iron pipe are used it will usually be necessary to make the joints with lead or other poured material. For transite pipe the joints are commonly made with a sleeve coupling filled with a bituminous compound. In the case of steel pipe mechanical joints are commonly used.

45. Inspecting Pipe.—The best way to get good pipe is to buy it from a first-class manufacturer. Purchase solely on a price basis is usually poor business. The average small community does not have facilities for testing the pipe and usually does not purchase on any specification, especially when small lots are bought. On large purchases, it is desirable to engage a testing laboratory to check and inspect the pipe at the plant. In any case, the pipe as delivered should be inspected, the manufacturer being responsible for its condition on delivery. Factors to be considered include:

a. The variation in straightness of a pipe should not be more than ⅛ in. per foot of length of pipe. That is, a 3-ft. pipe should not be more than ⅜ inch out of alignment.

b. The hair cracks or other fine cracks in the pipe should not impair its strength or serviceability.

c. Not more than 10% of the inside of the pipe should lack glaze. The outside of the pipe should generally be well glazed except glaze is not needed inside the socket or on the portion of the spigot end which will be covered by the jointing material.

d. Any chips or fractures inside the pipe should be small (generally not more than 1 inch by 2 ins.) and have a depth not greater than one quarter of the thickness of the pipe.

e. There should be no broken blisters. Unbroken blisters are permissible if not over 3 ins. in diameter (for 18-in. or smaller pipe) and ⅛ in. high.

f. There should not be more than one crack in the socket or in the pipe barrel and the dimensions of such cracks should be limited to locations and sizes that do not reduce the serviceability of the pipe.

46. Pipe Specifications.—The American Society for Testing Materials has prepared specifications covering both vitrified clay and cement concrete pipe. The specifications cover dimensions and permissible variations from them; strength; methods of testing; and many other factors. Most manufacturers comply with ASTM specifications. Copies of ASTM specifications may be obtained from the Society at 260 S. Broad St., Philadelphia, Pa.

47. Manholes.—Manholes are placed at every change in line or grade of a sewer, and at such other places that, with sewers smaller than 24-inch, they are not more than about 400 feet apart. This arrangement provides a perfectly straight line between each manhole and facilitates the location of stoppages in the line and cleaning of the sewer. Cleaning is often or usually done by rodding and it has become the invariable practice to make manholes at least 4 feet in diameter so as to permit the use of rods. The top of the manhole is tapered or domed to an opening of about 23 ins., on which a standard manhole frame and cover is placed.

The walls of a manhole may be of brick or lightly reinforced concrete. If of brick, the walls should be 2 bricks or 8 ins. thick laid in cement mortar and the outside should be plastered with cement mortar and

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made water-tight. A good concrete wall 6 ins. thick lightly reinforced is sufficient for depths to about 8 feet. On deeper manholes, the walls should be thicker. Up to 8-ft. depth, reinforce with ⅜ or ½-inch rods 6 or 8 ins. on centers. The flowing-through channels in the bottom should be of concrete lined with a half-tile, or shaped carefully. The base or bottom of the manhole is best made of concrete, about 8 ins. thick below the channel, and reinforced as directed for the walls. Above the half-tile lining for the channel, carry the concrete up vertically to, or above, the top of the incoming sewer. Slope the concrete back from the flowing through channel to the manhole walls about 2 or 3 ins. to the foot. Then if the manhole should flood, not much material will be stranded on the sloping bottom and this can easily be washed off. Place firm and substantial iron steps in the manhole walls to permit entering and leaving the manhole. These should preferably be of cast iron but ¾ or 1-inch reinforcing can be used; space about 15 ins. apart.

48. Other Details.—When large sewers are involved, manholes with an inside diameter greater than 4 ft. will be needed. In case of doubt, lay out the connection to scale on a piece of paper or on the floor. Branch sewers entering a main sewer should be joined to it with a smooth curve. The inverts of branch sewers are usually brought into the manholes somewhat above the invert of the main sewer—higher by about ½ the diameter of the main sewer. For instance, in joining an 8-inch sewer to a 12-inch, the invert of the 8-inch line should enter the manhole about 6 inches higher than the invert of the 12-inch line. If this is not done, the 12-inch sewer when it is flowing half-full or more will back up the flow of the 8-inch line and may cause enough solids to deposit to clog the smaller sewer.

Sometimes branch sewers are much higher than main sewers. In such cases, it is not necessary to dig down to the main sewer and bring the branch sewer in at this level; instead, an inverted T is placed in the line of the branch sewer just outside of the manhole, and a vertical pipe used to carry the flow down to the level of the main sewer, with an elbow at its bottom. The open end of the T should pass through the manhole walls for the double purpose of providing an opening for cleaning and as a relief.

49. Buying and Handling Pipe.—Recommendations have already been made that pipe be bought from wholly reliable firms and that it be of assured good quality. Local dealers sometimes purchase poor lots or rejects, for which there are legitimate uses on small drainage jobs. For sewer lines, only high-grade pipe should be used. This should be handled and stored carefully to avoid breakage or damage. When shipped by railroad, it should be unloaded carefully into trucks, hauled to the job and piled in a convenient place. When needed, it should be carried by hand to the trench, in the case of smaller pipe, and handed to the men in the trench. Special handling devices will be needed for large and heavy pipe. Inspection of the pipe may be made during the unloading from the car or truck in which it is delivered.

50. Testing Sewers.—The importance of having tight sewers has already been mentioned. It also goes without saying that sanitary sewers should not be connected to roof drains or other storm water sources.

For these reasons the work of laying sewers should not only be carried on under careful specifications and rigid inspection to see that the contractor or the foreman performs the work properly, but the sewer

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should also be tested to determine if, or how seriously, it leaks. There are several methods of testing, all of which are applicable before the sewer is placed in service.

Probably the best one is to arrange to test the sewer in sections between manholes, one by one. Plug the sewer where it enters the downstream manhole, taking care that no leakage will pass the plug. Plug the next upstream manhole where the sewer enters. Thus one manhole and one section of sewer is blocked off. Fill the sewer full of water and continue until the manhole also is partly full. A head of about 4 ft. on the upper end of the sewer is ample. Let this stand until manhole and pipe have ceased absorbing water, then the extent of leakage can be measured by the fall of water in the manhole or by the amount that must be added to keep the water level at the original mark. The leakage per 100 feet should not exceed 1 gallon per hour per inch diameter of pipe. For instance, the leakage from a 300-foot length of 15-inch pipe should not exceed 45 gallons per hour.

If the line is laid below ground water, the flow through the pipe before any connections have been made to it will indicate the leakage into the pipe. If the pipe has not been covered and water stands in the trench, it may tend to float, resulting in breakage. Floating will not occur when the line is tested by filling it with water. If the pipe has been covered and is found to be seriously leaky, it is difficult and costly to repair it. Uncovering may be the only means of doing so.

For this and other reasons, the maximum possible care should be taken to construct the line properly in the first place. There is never any saving through hasty and careless construction. The cost of future repairs is invariably many times as great as the saving obtained by poor initial construction.

51. Estimates of Materials Required.—For a manhole 4 ft. in diameter with walls 8 ins. thick, about 175 bricks per foot of depth are required for the walls; that is for a manhole 6 feet deep, about 1100 to 1125 bricks; 8 ft. deep, about 1400 bricks, etc. If the bottom of the manhole is made of brick, about 200 will be required in addition. Mortar also is required—about 3½ cubic feet per foot depth of the manhole, including that for a ¼-inch plaster coat outside of the manhole, but not including the bottom. A concrete bottom for a manhole requires about ¾ cubic yard of concrete.

The amount of compounds, as G-K, Sanitite, etc., required for sewer pipe joints should be learned from the manufacturer as the various compounds have different densities and weights. When cement mortar is used, it should be mixed 1 : 1 or 1 : 2, using standard portland cement and clean, well graded sand. One cubic foot of mortar will make approximately the following number of joints:

8-inch	40	15-inch	13
10-inch	32	18-inch	8
12-inch	21	24-inch	4

The conclusion of this instalment, "Laying Water Pipe," will appear in the November issue.

HERE'S ANOTHER CONVENIENT WAY TO MOUNT YOUR FLEXIBLE "EZY" ROD REEL

FLEXIBLE'S new, EZY Rod Reel eliminates the need for hooking and unhooking rods when winding or unwinding.

Many sewer departments are mounting the reel on the side, back, or inside of their service trucks or trailers to have them ready for use at all times.

This is only one example of the many time and money saving features of the FLEXIBLE line of sewer cleaning tools.

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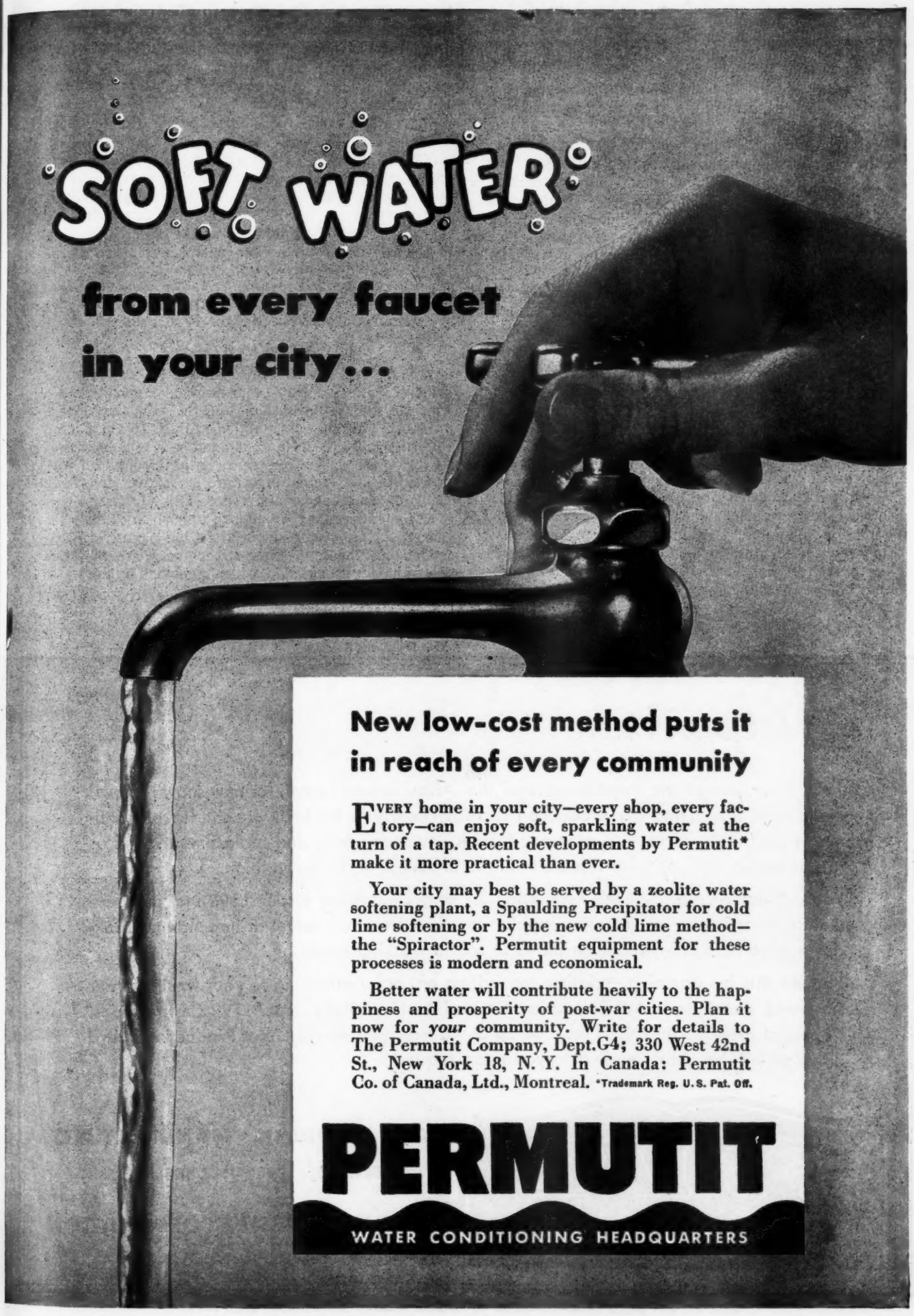

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PERMUTIT

WATER CONDITIONING HEADQUARTERS

Landscaping Sewage Treatment Plants and Sewers

(Continued from page 18)

river (into which the plant effluent discharges) has been cleaned out, carefully saving all good trees and bushes but destroying the poison ivy and briar bushes. Fireplaces and tables have been built and as a result many people frequent the place for outings. Many bird homes of different shapes and sizes have been distributed about the area. The more simple and natural the work is, the better it blends in with the surroundings and the more economical it is to maintain.

No special appropriation has been set up for the grounds. The plant operators do the work in their spare time. They prepare a compost pile, consisting of sewage sludge and leaves from the streets of the municipality. After two or three years the mixture is broken up and shredded by a Royer shredder. The resulting material is used as a mulch about the trees and bushes and is an excellent soil conditioner as well, and there is a great demand for it for use on Victory gardens. The trees need some trimming, and once a year for the past two years the red pines require a spraying to kill the saw flies which turn into caterpillars which eat the new pine needles. Recently experiments are being carried out with a saw fly parasite. Near the southwest corner of the Princeton plant site is a nursery where very small stock is started, and in another place natural white dogwood trees have been transplanted. South of the nursery is a rifle range for long range practice. Nearly all open spaces have been filled with planting. Besides the trees mentioned before, there is a sprinkling of blue spruce, cedar, Douglas fir, arborvitae, cypress, juniper, larch, lilac and many shrubs. It is a good idea to give the grounds an attractive name appropriate to the location or landscaping; for instance, we have named ours "Millstone Park," after the river which bounds it on one side.

The Princeton plant was not laid out by a landscape engineer, but the plan grew from year to year without much forethought, in spite of which it is quite evident that the planting has aided materially in making the plant surroundings a more attractive place. According to reports, it has often been mistaken for one of the many attractive estates about Princeton.

Resurfacing Winchester Ave., Ashland

(Continued from page 19)

mix being laid at 100 lbs. to the sq. yd. covering the brick only, leaving the gutters open. Asphalt rakers kept the surface levelled up and the joints and edges uniform. This was then rolled with a 10-ton Galion roller. A hot-mix finish or top course was then laid at 94 lbs. to the sq. yd. in strips of a uniform width with practically the same procedure as above described, using the same paver and roller. This top course covered the entire street from curb to curb, including the gutter. At the street intersections the paving was extended out the connecting streets to where the state determined it should stop, which depended on the grade and condition of the intersections. All places inacces-

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sible to the roller were hand tamped, and all manholes, valve boxes, etc., were raised to finished surface grade ahead of the paving. This material was hot mixed at the plant and trucked to the job in covered beds to retain the heat.

Part of this construction was completed last fall, and after a hard winter combination of rain, snow, freezes and thaws it still retains its smooth texture with no signs of a breakdown at any place. From a safety standpoint I believe it is as near skidproof under all weather conditions as any type of surface available.

With the exception of a few days of inclement weather, this job was very efficiently and expeditiously carried out, and, due to the quick-setting qualities of this type of material, there were no traffic holdups or problems involved. I believe we now have one of the finest surfaced streets in any city. We have had several inquiries about it from interested officials of other counties, cities and states.

Obstruction of Sewer as Negligence

The function of a public storm-water sewer, the Iowa Supreme Court holds, is to gather and carry away storm water, and it may be inferred that substantially its entire capacity is, from time to time, required for that purpose. A public service corporation which, for purposes foreign to the regular functions of such sewer, places or maintains an obstruction therein, should, in so doing, exercise reasonable care to prevent injury to others resulting therefrom. "Reasonable care" is care commensurate with the danger thereby entailed and requires the anticipation and guarding against such contingencies as are reasonably apparent and reasonably likely to occur. That is not to say that every partial obstruction of a sewer by a licensee public utility would necessarily constitute negligence. But the licensee would be negligent if it obstructs the sewer in such a way as to reduce its capacity, modify its flowage, place additional strains upon it, or otherwise affect it to such an extent that injury to others is reasonably apparent and reasonably likely to result therefrom. Latham v. Des Moines Electric Light Co., 296 N. W. 372.

Annual Cleaning of Sewers

The sewer system of Lewiston, Idaho, contains 30.2 miles of 6" to 36" sewers. "About 20 miles of 6" and 8" laterals are rodded and cleaned each year, work starting in the late fall after the growing season is over, and continuing into early winter. We have found that by cleaning the smaller laterals each year, most of our root trouble is avoided and we have very few plugged sewers. A new flexible power drive purchased two years ago has speeded up rodding and reduces the number of man-hours required."

Virginia Plans "Horse-and-Buggy" Road

A combination "horse-and-buggy" road and a modern motor highway is provided in plans drafted by Virginia State Highway Officials. The 3.34-mile project between Front Royal and the Army Remount Depot calls for construction of a 14-foot, top-soil wagon road alongside a new 22-foot-wide, high-type highway. If these plans materialize the wagon way will be the first road built for horse-drawn vehicles by the Virginia Highway Department.

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THE Pitometer survey described elsewhere in this magazine uncovered 500 live services leaks, 356 dead services leaks, 63 joint leaks, 54 broken mains, and 15 miscellaneous leaks, or a total of 988 leaks, 40 slow meters, and 3 cases of unauthorized use—a grand total of 1,031 items that caused a loss of 21,820,000 GPD.

WATER IS A CRITICAL MATERIAL

Adequate rainfall has literally saved many a water department and its dependent war industries this year. But can you count upon its continuance? What would a drought do to your supply?

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Preventing Freezing of Elevated Steel Tanks

By WALTER H. METCALF

Pittsburgh-Des Moines Steel Co.

A steam-tested radiator in a large riser pipe is successful in North Dakota cities.

THE formation of ice in elevated steel tanks is influenced by the amount of water circulating through the tank, the temperature of the water as it enters the tank and, of course, the outdoor temperature, and the length of the periods of prolonged cold weather.

In the early days from 1909 to 1919, tanks were built in North Dakota with 8-inch riser pipes and four-ply three-air space wooden frost cases. Later some experimenting was done with 2-inch hot water pipes located inside the frost case and extending into the tank. Enlarged frost boxes were also built around the expansion joint and extending out around the saucer plate in the tank bottom.

In 1929 the idea of using a large diameter steel riser pipe, five or six feet in diameter, was tried along with a steam boiler and double pipe heater unit extending to the tank bottom inside the steel riser.

All of these plans had their faults and in 1936 the consulting engineers in North Dakota developed the idea of using a hot water heater with the large diameter steel riser. This layout consists of a hot water boiler with a 1½-inch diameter discharge pipe extending to the tank bottom. This pipe is enclosed in a 4-inch capped pipe which acts as a radiator and is in direct contact with the water in the steel riser. A return line runs to the boiler from the bottom of this 4-inch pipe, which also encloses a ¾-inch diameter open top air release pipe which extends a short distance above the hot water pipe.

There have been fourteen of these installations made since 1936, and results have been reasonably successful. A recent questionnaire has brought out some difficulties encountered which will be avoided on future installations.

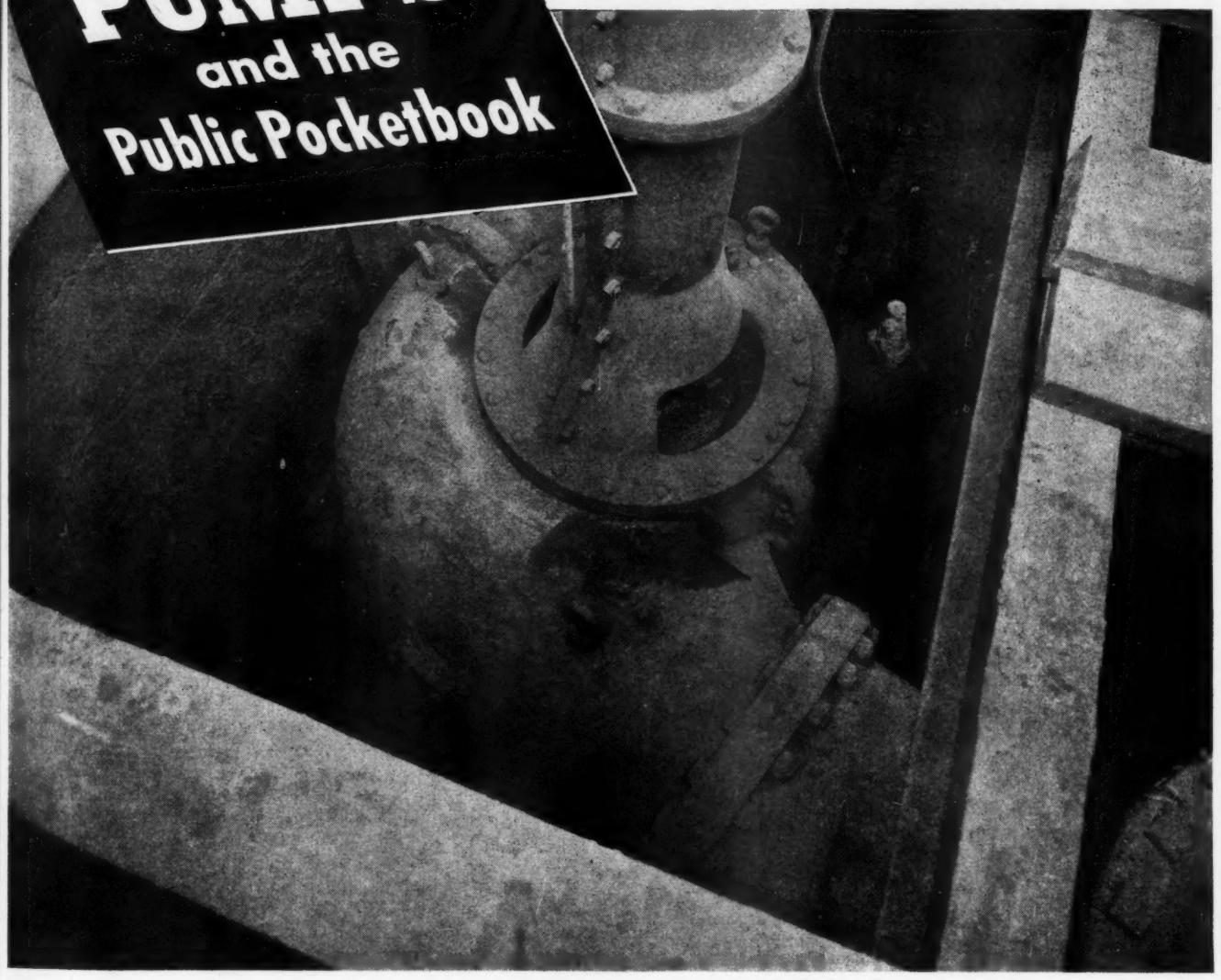
Each installation presents a somewhat different problem, as the amount and temperature of the water used varies, as does the kind of fuel used. There is, no doubt, a natural tendency to fire too heavily during the first winter the tank is in use. The amount of water used usually increases as the system grows older and this factor helps to reduce the amount of heat required. On the basis of this recent survey, it seems that this hot water system has successfully prevented expensive freeze-ups and is far better than methods tried in earlier years.

The above, which appeared in the "Official Bulletin" of the North Dakota State Department of Health, was accompanied by a tabulation of the questionnaire replies from the 14 cities which shows that the risers were 5 ft. in diameter in 9 of the cities and 6 ft. in the others. The heating is done with lignite briquettes in 8 cases, hard coal in 2, soft coal in one, and natural gas in 2; while one does not heat the house.

In general, the cities report the system is satisfactory, but three say the fire box is too small; two find a circulating pump improves the operation, and one finds closing the air relief valve an improvement. Two of the plants had been in use six years; three of them five years, four of them four years, four of them three years, and one of them two years.

PUMPS and the Public Pocketbook

This Fairbanks-Morse 24-inch angle flow pump has a capacity of 20,000 G.P.M. against a 25-foot T.D.H. Submerged in a pit, it is seen by relatively few of the citizens of Granite City, Illinois. But it is saving money for them every year.



MOST of the citizens of your city don't know what kind of pumps are serving them. Pumps themselves are not in the public eye. But they are very much in the public pocketbook . . . for this reason: many old pumps, even if as good as the day installed, cost as much as 10% more to operate than Fairbanks-Morse Pumps of modern design. At that rate new Fairbanks-Morse Pumps soon pay for themselves. From then on the saving can be used to help reduce city taxes. Postwar federal taxes are bound to be high. That can't be avoided—but it can be helped. Plan *now* to install new Fairbanks-Morse Pumps as soon as they are available for civilian service. Fairbanks, Morse & Co., 600 S. Michigan Avenue, Chicago, Illinois.

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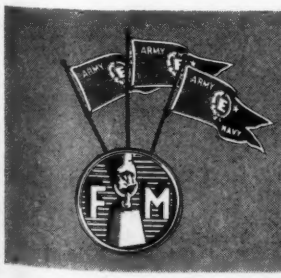

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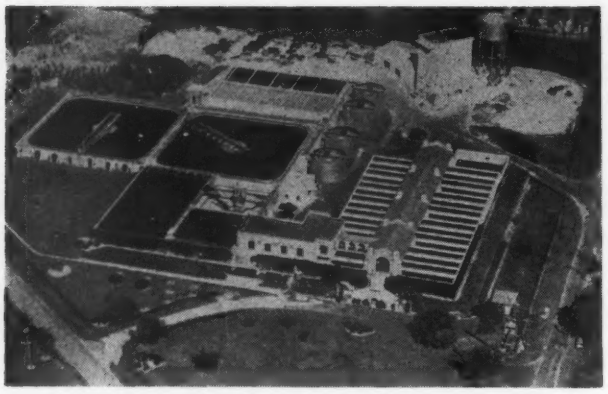


Aerial view of the Miami, Fla., water purification plant.

The Waterworks Digest

Abstracts of the main features of all important articles dealing with waterworks and water purification that appeared in the previous month's periodicals.

Lining Small Mains in Place

Three processes for lining small mains in place. One, the Tate, has been used in this country and described in PUBLIC WORKS. Another, the Eric, developed in England, consists of cleaning the mains, pumping a bituminous emulsion into the cleaned section, and drawing through it an electrode from which direct current passes through the emulsion and deposits a thin, continuous coating of bitumen upon the wall of the pipe. English experience indicates a possible life of 10 yrs. for the coating. The third process, less well known, involves cleaning, drying, and brush application of two coats of bituminous paint by a special brushing mechanism.[B13]

Power Valve Operating Devices

In New York City's distribution system there are 141,000 valves, of which 4,200 are 20″ to 48″, the latter in 72″ pipe. It takes a minimum of 12 min. to close a 20″ valve by hand, 45 min. to close a 48″ valve, and much longer if the pressure is all on one side, as after a break in the main. To reduce this time, the city now uses motor-driven valve operating mechanisms. Four were purchased in 1923 from Payne Dean & Co., 8 more prior to 1942, and 20 in 1942 to prepare for war emergencies. The essential feature of the device is a head casting, containing gears and universal joint, which fits over the operating nut of the valve. It slides in and out at the left hand side of the truck on a track riveted to the underside of the chassis, and is driven from a heavy-duty reversible power take-off attached to the truck transmission; there being two universal joints and a bevel gear unit. Fifteen of these are installed on 2-ton trucks, the others on 1½-ton; the former being preferred as sturdier. The devices cost about $1,000 each. Each carries a revolution counter to show the number of turns made. To protect the valve, a shear coupling is installed on the shaft provided for the use of 1, 2, 3 or 4 brass shear pins, and no valves have jammed or stems been broken. The maximum speed used is 120 rpm. Crank handles permit operating the valve by hand if desired.

In closing a 36″ valve on a 48″ main in three minutes, the valve being 6600 ft. below a free entrance to the main, the pressure rose from 30 psi to 44, returned to 30 in a few minutes, increased to 33, then became constant at 30 psi. In the case of a 20″ main, cross-connected to 12″ mains at intervals of one or two blocks, closing a 20″ valve in one minute increased the pressure from 66 psi to only 67 psi because of the cross connection.[F55]

Removing Iron and Manganese

A method of removal satisfactory for one well may not be so for another only 100 ft. away, because of possible differences in metallic content. Thus far no single, simple and economical procedure has been developed which can be adopted as a standard method for all problems involving iron and manganese in water. On the contrary, in 50 yrs. of development the trend has been away from standardization and routine operation and toward specialization in both treatment methods and operating technique.[F63]

Controlling Taste and Odor in Reservoirs

Lake Ashburton reservoir, Baltimore, Md., 200 mg capacity, in 1939 became so infested with evil taste-producing organisms that continuous dosing of it with 2 lb. or more of copper sulphate per mg was necessary, and this gave the water a metallic taste. It was found that the water was entering and leaving the reservoir at the same point, giving no circulation in the reservoir, which was thought to be one cause of the condition, and the inlet was changed to the other end of the reservoir. Also, instead of pumping at the same rate as the consumption, the pump was operated intermittently at a rate 1/3 greater, causing the water level in the reservoir to rise and fall. This gave immediate results, but the tastes continued because of a layer of dead algae on the reservoir bottom. By dosing with chlorine so as to obtain residuals in the reservoir from zero at the surface to 1.25 ppm at the bottom the taste was cured. This chlorine blanket method has since been used at all reservoirs where tastes appear, the effluents receiving only small finishing doses. The reservoir doses are 30 lb. per mg in warm weather and 20 in cold. The chlorine does not prevent algae growths on upper slopes of the reservoir sides, and one pound of copper sulphate per mg is applied twice a week during August and September around the edges of all reservoirs as a preventive.

To test the blanket theory, chlorination of Lake Asburton was stopped abruptly and in 3 days the water was filled with black colloidal particles.[F57]

Why Denver's High Water Consumption

Denver, Colo., water consumption averages 175 gpd per capita; about 115 gpd in winter but reaching 415 in summer because of lawn sprinkling. No effort is made to reduce this because the water is obtained from mountain streams in which the city owns water rights and, by Colorado law, if such rights are not used, they may be acquired by others who could use it; therefore they are used to retain the rights for a future increase in population.[F60]

Manganese Removal by Zeolites

Edgeworth, Pa., consumes about 370,000 gpd of well water whose hardness varies from 220 ppm to 150, and managanese content from 1.4 to 2.9 ppm. The water is softened in two 10 x 15 ft. units containing 40″ of green sand; and demanganized in two 6 x 5½ ft. units containing 30″ of green sand. The water first passes through 2″ of fine gravel to remove crenothrix and sand. The deman-

ganizer units are operated in an upward direction at about 10 gal. per sq. ft. per min., the water overflowing a wash trough, just as in filter backwashing. Regeneration is accomplished by drawing down a dilute solution of potassium permanganate into the sand, holding it there over night, then washing out to waste. In 1942, average results were: manganese reduced from 1.9 to 0.17 ppm; hardness from 172 to 85 ppm; 1.67 lb. of permanganate used per lb. of manganese removed. Cost of hardness removal, $9.50 per mg; of hardness and manganese removal, $11.73 per mg.[F61]

Emergency Reservoirs In England

Eight large emergency reservoirs have been built in Margate, four with solid concrete walls and floor, half sunk in the ground; the others in a school playground, a park lake, a bandstand area, and a parking place. The first four had floors made in slabs 20 ft. square, with lead strips at the joints. These were all watertight except one, which leaked at the overlaps of the lead strips (which were not soldered together).

The playground was walled in and had a tar macadam surface. The walls were reinforced with sufficient concrete to give them gravity resistance to overturning. The floor was constructed of concrete as above, on top of the original tar surface. This has remained perfectly watertight.

The park lake was covered, bottom and sloping banks, with concrete (4″ to 5″ thick where a bomb had broken it). A wall was built around it inside the banks to raise the water from 1.5 ft. depth to 4.5 ft. Irregular cracks in the floor were covered with "hessian" cloth (similar to burlap) and a bituminous paste. This was filled and was tight at first but in 6 weeks the water was falling ¾″ a day. It was found that a number of new cracks had developed in the floor, which was then covered with 1:3 cement mortar.

The largest reservoir was that made by surrounding the parking place with a gravity wall built on the 5″ concrete surface. The floor had many fine surface cracks and was covered with two coats of asphalt road emulsion, after covering all cracks with hessian and asphalt paste. After standing full of water for 12 months, a leak developed along the inside edge of one end wall. This crack was cut out, calked with lead wool, and covered with hessian and asphalt, and has remained tight.[D15]

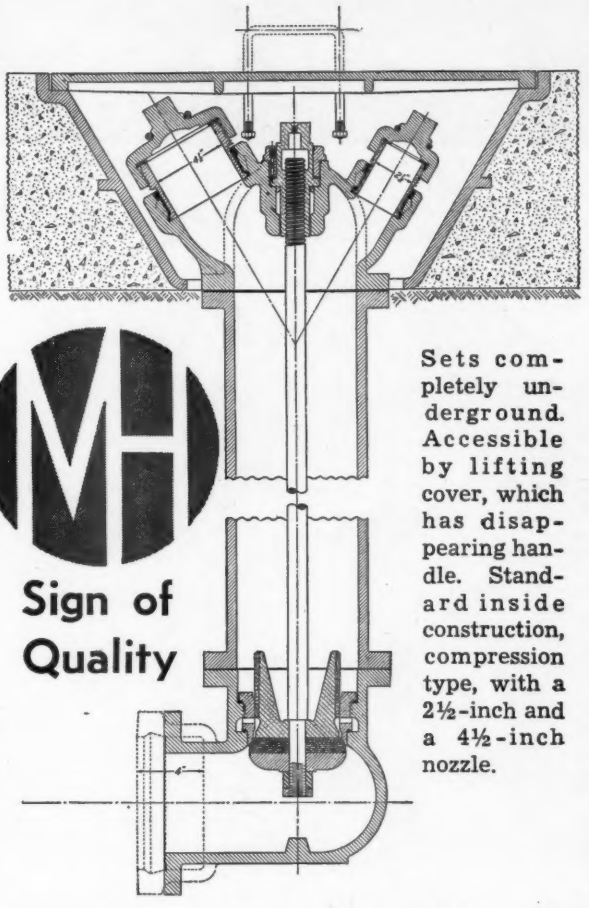
Repairing Meters By Grinding in Chambers

Elgin, Ill., in 1942 saved 509 potentially worn out meter chambers by the grinding in process and expects to save 500 this year. After cleaning the measuring chamber with acid the surface is polished with a fine wire brush, including thrust roller slot and diaphragm. The disc is assembled in the measuring chamber and revolved counter clockwise. If it binds at any point, fit it to just touch this high point by using an oversize ball or by shimming. Smear grinding compound over the top and lower ball and on the chamber sockets. Clamp the chamber together with the piston inside and place it in a jig fastened on a drill press stand and spin the piston by means of the drill shaft, slowly turning down the wing nuts as far as they will go. Then remove chamber and wash off all abrasives. Reassemble and revolve the piston by hand. If it binds at all, repeat. The method, properly executed, will make the chambers register sensationally low-flow accuracies, providing the rest of the meter is in repair and properly aligned. The time required is 15 or 20 min.[G32]

Performance of Double Check Valves

The Connecticut State Dept. of Health between 1927 and 1942 made 8550 tests of the 148 double check valves on cross connections in that state. It found 156 leaks in outside check valves, 19 leaks in inside check valves and 7 leaks in both valves. Since 1929, however, it has found only one installation leaking in both valves. Much better

FLUSH TYPE
Fire Hydrant



Sets completely underground. Accessible by lifting cover, which has disappearing handle. Standard inside construction, compression type, with a 2½-inch and a 4½-inch nozzle.

Sign of Quality

Used in places where a standard hydrant, protruding above ground, might interfere with traffic or industrial operations. Furnished complete with Cast Iron nozzle box and cover.

M & H STANDARD FIRE HYDRANTS are revolving head, dry top, bronze mounted. They are approved by "UA&FM." Entire main valve assembly is removable through barrel without digging. Special Traffic Model is fitted with breakable bolts and stem coupling, designed to break at ground line under impact. Repairs are made simply by renewing bolts and coupling, without shutting off the water.

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GATE VALVES
TAPPING VALVES
WALL CASTINGS
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FLOOR STANDS
EXTENSION STEMS
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results are given by the 44 all-bronze valves than by the iron body valves. Valves smaller than 6″ do not seem to be dependable. In most cases grit or sediment on the seat of the valves was responsible for the leak.[G34]

Bibliography of Waterworks Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n,* note or short article; *p,* paper before a society (complete or abstract); *t,* technical article.

B *Journal, New England Water Works Ass'n*
September

13. Measures Taken at Falmouth, Mass. to Control "Red Water" and Tuberculation of Mains. By E. Sherman Chase. Pp. 173-185.
14. New Trends in Ground Water Development. By Ross Nebolsine. Pp. 186-200.
15. Rainfall in New England. By George V. White. Pp. 201-259.

D *The Surveyor*
August 6

15. Leakage Troubles in Emergency Reservoirs. By W. L. Armstrong. P. 329.

August 13

16. *p.* Problems of the Sanitary Engineer Arising From Enemy Air Attacks. By Gordon S. McDonald. Pp. 335-337.

F *Water Works Engineering*
August 25

55. Use of Mobile Power Unit to Operate Valves. By Tobias Hochlerner. Pp. 926-929.
56. *p.* Water Supply Practice in Army Training Centers. By Lewis H. Kessler, Maj. V. Bruce Sundstrom and Arthur O. Tomek. Pp. 930-934, 950.

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57. Taste and Odor Control by Reservoir Chlorine Blanket. By Gordon L. O'Brien. Pp. 996-999, 1050.
58. Practices in Racine, Wis. By Walter A. Peirce. Pp. 1000-1004, 1043.
59. "Critical Area" Supply Problems of a Suburban Plant. By Hugh S. Dewey. Pp. 1005-1006, 1040.
60. Financial Story at Denver, Colo. By George F. Hughes. Pp. 1007-1010.
61. Softening and Manganese Removal by Zeolites. By D. E. Davis. Pp. 1012, 1015-1017.
62. Salt-Velocity Gagings of Flow in Delaware Water Tunnel. Pp. 1020-1021.

September 22

63. Treatment Problems With Iron and Manganese. By Samuel M. Ellsworth. Pp. 1072-1076.

G *Water Works and Sewerage*
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32. Water Meter Repairing—Strictly an Art. By La Verne Trentlage. Pp. 317-321.
33. *p.* The Control of Corrosion. By Robert Spurr Weston. Pp. 323-327.
34. Double Check Valve Performance. By Frederick O. A. Almquist. Pp. 329-333.
35. Miller Pipe Locating Magnet. By Basil Miller. Pp. 335-336.
36. The Story of the Fire-Line Meter. By Robert E. Ferguson. Pp. 341-344.
37. Liquid Chlorine in the Treatment of Water and Sewage. By E. Sherman Chase. Pp. 345-346.
38. Ferric Salts in Water and Sewage Treatment. By Francis K. Burr. Pp. 347-351.

J *American City*
September

19. Cement Joints for Water Mains. By H. J. Graesar. Pp. 61-62.

M *Water and Sewage*
August

16. How the Army Gets Water. Pp. 15, 38.
17. *p.* Efficiency of Water Purification in Removing Polio Virus. By H. J. Carlson, G. M. Ridenour and C. F. McKhann. Pp. 16-18, 41.
18. *p.* Waterworks Distribution Systems in Wartime. By W. P. Tarbell. Pp. 24, 39.

P *Public Works*
September

43. Some Aspects of Driven Well Construction. By H. R. Shipman. Pp. 16-18.
44. Foundation Grouting of a Reservoir. By Harry C. McCrea. Pp. 23-24, 28.
45. *n.* A Covered Reservoir Without Reinforcement. P. 40.

Installing a Turbine Pump at Roxboro

(Continued from page 16)

tion and behaved beautifully, not even a minor adjustment being necessary. When pumping 950 gpm (according to our raw water meter) there was no vibration—a nickle was easily balanced on edge on top of the motor. The pump was stopped and started by remote control from the filter plant with the same perfect results. We use this pump more often now as the demand increases, and I am satisfied with the results obtained.

Sewage treatment plant at Bagley, Minnesota.

The Sewerage Digest

Abstracts of the main features of all important articles dealing with sewerage and sewage treatment that appeared in the previous month's periodicals.

Operating the Cranston, R. I., Plant

This plant, treating about 2.5 mgd, was described fully in PUBLIC WORKS for May 1943. It is being operated by a force of 8 men—superintendent, chemist, 3 plant operators, filtration and incineration operator and 2 laborers; the payroll being about $16,000 a year. Chemicals and all other expenses cost about $18 per m.g. Of the present flow of 2.4 mgd, 415,000 is ground water leakage, 500,000 gal. is domestic sewage, 160,000 is brewery wastes and 1,325,000 gal. is settled print works waste. Average results—about 92% to 97% reduction in B.O.D. and 87% to 91% in suspended solids. Sludge cake from the vacuum filters is in so much demand for use as fertilizer that the price has been advanced from the original 30 cts. to 50 cts. per cu. yd.[L5]

Low-Cost Treatment for War Plant

A treatment plant for an ordinance works employing 4500 people in three shifts that could be installed quickly and at low cost and be simple to operate was built by force account by the Huntington, W. Va., U. S. Engineer Dist. for $42,700 in about two months and requires only part-time attention of one-man, with occasional laborers for removing sludge. Only primary treatment was necessary, with sludge drying on open beds. The settling tank has two hoppers, no sludge removing mechanism; is divided into two sections by wooden partitions. There are two concrete digestion tanks operating in series. Gas is collected and used for heating. Screens are hand raked. Sludge and scum are pumped daily to the first-stage digestion tank. Supernatant from the second-stage tank goes to the settling tank.[E18]

Aerating Improves Supernatant

Carmel, Calif., treats its 400,000 gpd of sewage in a clariflocculator and a primary and secondary digester. There is no way of selecting the depth in the latter from which to withdraw the supernatant, and this carried so much fine suspended matter that it clogged sand beds and, if turned back into the clariflocculator, caused it to give an undesirable effluent.

The supernatant overflow pipe leaves the tank 10 ft. above the ground, and the operator built a fish ladder with shelves 6″ apart, set on an incline so that the supernatant falls into it and down over the shelves, thus being well aerated. After this, much of the suspended matter settles out. He contemplates putting a cover on the fish ladder trough, making it a tube and blowing air into the bottom, if greater aeration seems desirable.[H38]

Sludge Drying At Chicago

The sewage flow to the Chicago treatment plants in 1941 averaged 1064 mgd carrying 729 tons, dry weight, of suspended solids. Between 1922 and 1930 full-scale tests were made on dewatering, drying, digestion and other methods of disposal of the sludge from this sewage. In 1932 tests were begun in dewatering, drying and incineration in a pilot plant at the West Side Works with a capacity of 20 tons of dry solids a day. In 1934 flash drying was started and was so promising here that it was adopted in designing the Southwest plant. In this plant, which in 1941 handled 185 tons per day of dry solids, the sludge is concentrated and then pumped to conditioning apparatus, where it receives 6% to 9% ferric chloride (dry solids basis), using as a guide the pH value of the conditioned sludge, which is recorded in a continuous graph. The sludge is then dewatered to 80%-85% moisture on 32 vacuum filters, and is mixed with sufficient previously dried sludge to reduce the moisture of the mixture to 40%-50%. Then it is passed by belt conveyor to 8 drying units and mixed with superheated vapor in squirrel-cage mills, reducing the moisture to 5% in 5 min. Provision was made for burning the dried sludge, which has a heat value 0.57 that of coal, but it is all being sold as fertilizer.

This method does not produce offensive wastes and odors, and, although methods of decreasing the cost will no doubt be evolved, it is functioning very satisfactorily and the Southwest works are being enlarged along similar lines.[K9]

Bibliography of Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

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18. Low-Cost Sewage Treatment Facilities for a War Plant. Pp. 92-94.

G — *Water Works and Sewerage*
September

20. *p.* Community Sanitation in Wartime. By Arthur D. Weston. Pp. 337-339.

H — *Sewage Works Engineering*
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37. 50,000 Hours of Gas Engine Service. By William H. Gottlieb. Pp. 412-414.
38. Fish Ladder Aerator Improves Supernatant Liquor. By Bernard Rowntree. Pp. 415-416.
39. Hints on Care and Operation of Small Treatment Plants. Pp. 417-418.
40. Keeping Plants Running in War Time. Symposium. Pp. 419-421, 434.

J — *American City*
September

12. Sewerage in San Diego for National Defense. By Harold Keen. Pp. 56-58.

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September

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L — *Civil Engineering*
September

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August

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P — *Public Works*
September

36. Englewood's Sewage Pumping Station. By Russell Hartley. Pp. 11-13.
37. Effect of Discontinuance of Chlorination of Sewage Plant Effluent. P. 18.
38. Two-Step Lime Addition for Sewage Coagulation and pH Control. By Willem Rudolfs and G. B. Nickol. Pp. 30, 32.
39. *n.* Activated Sludge Study at Ann Arbor, Mich. P. 48.

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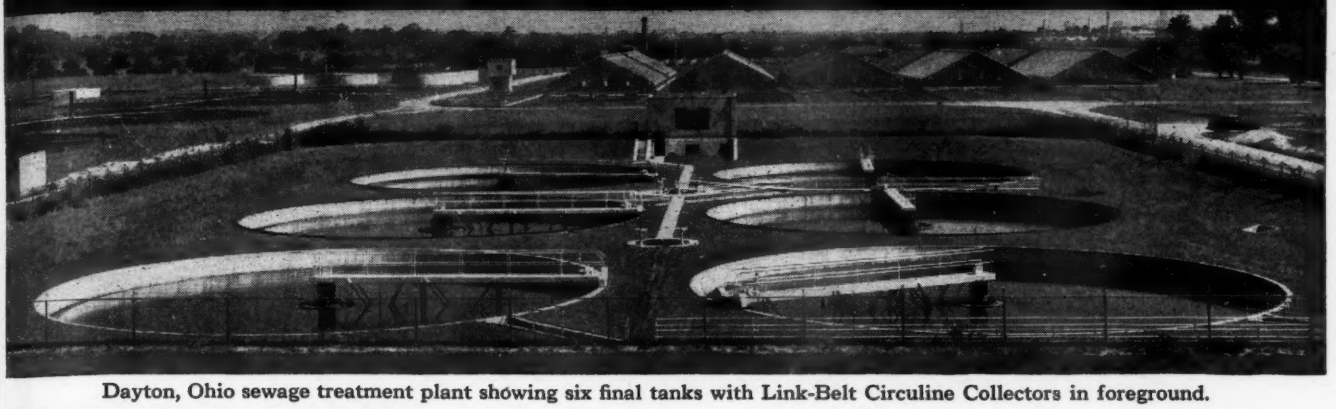
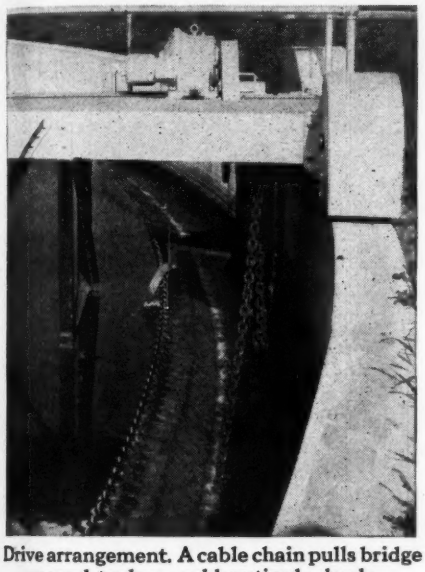
STRAIGHTLINE SLUDGE COLLECTION IN ROUND TANKS



Dayton, Ohio sewage treatment plant showing six final tanks with Link-Belt Circuline Collectors in foreground.



Drive arrangement. A cable chain pulls bridge around tank on rubber tired wheels.

THE CIRCULINE COLLECTOR

provides round tanks with the same important features which have made the Straightline Collector the acknowledged standard for rectangular tanks. It consists essentially of a straightline-type conveyor and sludge plow mounted on a revolving bridge supported at center and periphery of the tank. This removes the settled solids into a sludge channel from which the sludge is withdrawn. The entire floor area of the tank is cleaned of sludge during one complete revolution of the bridge. A slow, rotational speed allows only the minimum disturbance to the settling efficiency of the tank. The sewage is introduced into center of the tank through a conduit under the floor of the tank and uniformly distributed by two concentric baffles.

LINK-BELT COMPANY 8324

Philadelphia 40, Chicago 9, Cleveland 13, Indianapolis 6, Los Angeles 33, Toronto 8.
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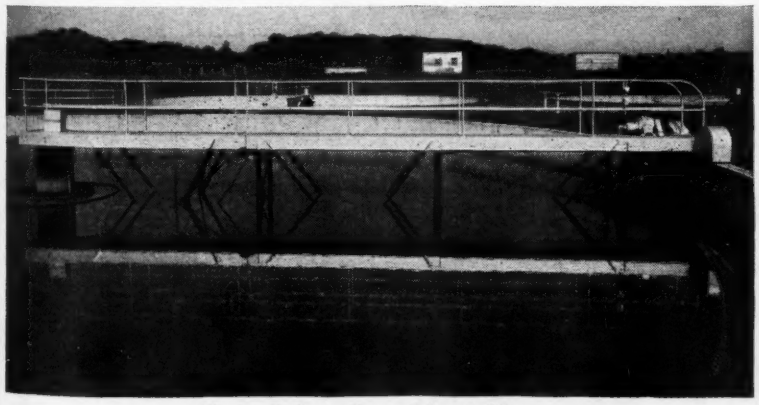
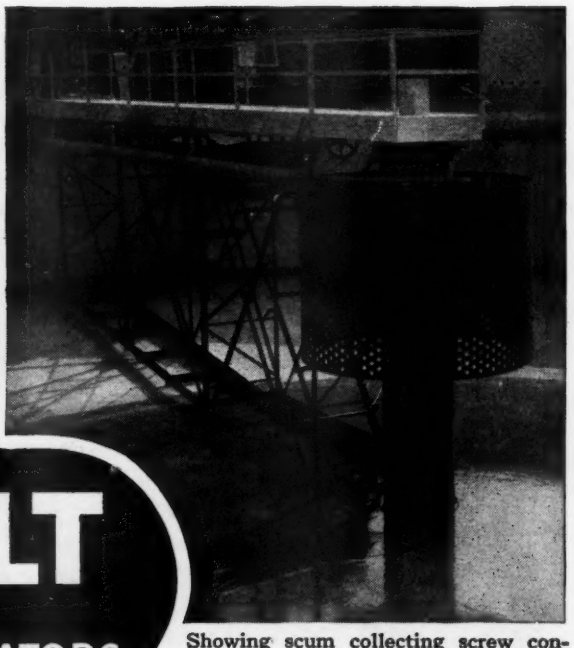


General view of revolving bridge.



Showing scum collecting screw conveyor and Straightline Collector in primary tank.

LINK-BELT

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When you need special information—consult the classified READER'S SERVICE DEPT., *pages 69-73*

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Keeping Up With New Equipment

Frost Prevention Report Spurs Subgrade Treatment

Calcium Chloride Association
4145 Penobscot Bldg., Detroit 26, Mich.

Much interest has been noted in the report in the 1942 Highway Research Board Proceedings covering the "Use of Calcium Chloride in Subgrade Soils for Frost Prevention", as investigated by F. O. Slate, research chemist at Purdue University.

Practical application of the findings is being undertaken by a number of highway and airport engineers, by impregnating frost boil areas with calcium chloride to prevent subgrade freezing, detrimental heaving and eruption, according to advices from the field.

Comparatively small percentages of calcium chloride in soils will prevent detrimental heaving, the report shows, and "as a general average, it can be said that protection from frost heave in silt is afforded by 2 per cent calcium chloride, in clay by 1 per cent and in graded mixes by ½ per cent."

Treatment of open surfaces and base courses under construction is generally being accomplished by uniform spread of flake calcium chloride over the surface to provide protection for 6 to 12 inches of depth and is worked in by scarification or similar means. Surfaced areas are being treated by backfilling a series of borings with a mix of 2 parts of sand or pea gravel to 1 part of calcium chloride.

Considerable interest also is indicated in soil treatment with concentrated calcium chloride solution which may be expected to disperse more readily, minimizing the need of scarification in the open-surface method, and the depth of the holes in the boring method.

The permanency of such treatment is not established, but tests show that there was very little loss of calcium chloride content after five years in base courses under black-top surfacing. One engineer reports a frost boil treatment costing $35 was 100 per cent effective through its first severe winter and adds that the treatment cost less than the emergency maintenance cost would have been for one spring breakup.

The Calcium Chloride industry is planning further research on the subject, and in the meantime is cooperating in special treatment work through its field representatives. Reprint copies of the State report are available on request to the Calcium Chloride Association.

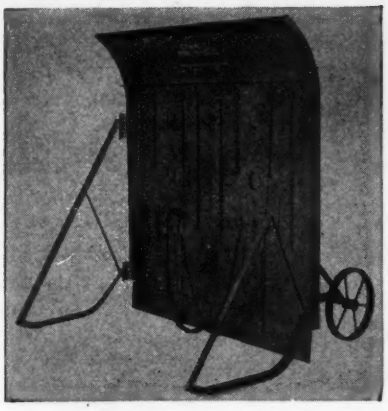
New Fire Shield Meets Timely Needs

American-LaFrance-Foamite Corporation
Elmira, N. Y.

For fighting fires out in the open, refinery, and particularly for use on airplane landing fields, the new Foamite Fire Shield fills a long-felt want. It is ruggedly built for hard, tough service, of sheet steel, reinforced with strong angle irons.

Between the front and back plates of the Foamite Fire Shield is an insulating mineral wool blanket, one inch thick, capable of withstanding a temperature of 1200° Fahr.

The three observation ports and the four nozzle ports are each equipped with pivoted cover doors con-



Foamite Fire Shield.

trolled from the rear of the shield. Sturdy anchoring chains are provided for securing playpipes in place.

At the base of the shield are three hinged skirts, which give way readily upon meeting any ground unevenness.

The wheel carriage is bolted to the shield body, so that the parts may be packed knocked-down, to permit of a minimum transportation space. The rear supports of the fire shield give great stability. They are hinged to fold against the shield body for shipment, and when being wheeled into action. A full length handle bar extends the full width of the shield at the top. Two short handles, normally hanging down, may be used to maneuver the fire-shield at the scene of the fire.

The Foamite Fire Shield is of particular value in the close-up fire fighting required when carbon-dioxide gas is used. The shield affords ample protection. It is 79½" high by 75¾" wide overall.

Various Controls Cause SterElatorS to Function in Different Ways

Everson Manufacturing Co.
214 W. Huron St., Chicago 1, Ill.

The manufacturer says: "SterElatorS are so designed that the basic unit remains unchanged but by adding various controls can be converted to perform its functions in various ways.

The manually controlled, solution feed, vacuum type SterElator is the basic unit and is used where constant feed at a fixed rate is satisfactory. The rate of feed can be changed manually within a ratio of 10 to 1 by using the chlorine control valve.

By the addition of a solenoid valve this basic unit becomes semi-automatic in its function, starting and stopping with the plant pumps, but it still feeds chlorine gas at a fixed rate while operating.

By adding a flow operated device which converts the rate of flow into differential pressure, the basic unit becomes a Hydro-Matic proportioning unit which automatically proportions the flow of gas to the flow of liquid being treated within a ratio of 5 to 1.

By adding a flow operated device, an electric "Robot" and an automatic gas throttling valve, the basic unit becomes an Electronomatic proportioning unit with a ratio of 10 to 1. The Electrono-Matic Ster Elator also visibly indicates the flow of liquid being treated.

Meters are available which when added to the Elec-

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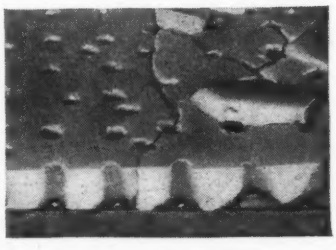
CAUTION, MR. ENGINEER!

VITAL TRAFFIC MUST GET THROUGH SAFELY THIS WINTER!

It's your responsibility—your share in the war effort—to see that storms don't delay trucking of war supplies. But in your battle to keep highways and streets open you have a sure ally in Sterling "Auger-Action" Rock Salt. Applied at the beginning of a storm, it will keep the snow from packing and bonding to the pavement—makes complete removal easy. Keeping pavements bare this way is safest. Tests show that it takes 2½ to 7 times as long to stop a car on ice as on bare pavements!



If caught by a storm ... and the snow has already packed down hard, you can still count on the efficiency of Sterling Rock Salt. Just as you see it in the model here, Rock Salt digs in fast. It melts the snow and ice, forming a brine which loosens the bond between pavement and ice. Thus loosened and honeycombed, the snow and ice can easily be removed. Further, when Straight Rock Salt is used, it eliminates the cost of cleaning streets and catch basins which ordinarily become clogged with sand and cinders during thaws!

Sterling

"Auger-Action" ROCK SALT

FOR ICE PREVENTION

Write today for bulletin containing all the facts on the most efficient and economical solution to your ice prevention problems. Free consultation with an International Field Engineer upon request. International Salt Company, Inc., Dept. P. W. 10, Scranton, Pa.

When writing, we will appreciate your mentioning PUBLIC WORKS

trono-Matic SterElator will totalize and record the flow of liquid being treated.

By using electronic timing devices the basic unit is converted to intermittent operation with definite but adjustable cycles on and off."

Portable Universal pH Indicator

Leeds & Northrup Company
4934 Stenton Ave., Philadelphia 44, Pa.

Anyone in laboratory or plant who needs to measure pH by means of a convenient, speedy and accurate portable indicator should be interested in a new 16-page catalog just issued by Leeds & Northrup Company.

It describes a new and improved portable universal pH indicator which, direct reading with glass, hydrogen and quinhydrone electrodes, combines the same sound measuring principle and durable qualities of its predecessor with the following added advantages: (1) self-contained electrodes of new and improved design; (2) in addition to the standard 50 ml sample beaker, a small volume holder for samples of approximately 2 ml; (3) a reduction in the number of knobs and switches used in standardizing and measuring; (4) a polarity reversing switch for the volt range.

Compactly housed in a light weight carrying case, it is said to be easily accessible because of the quickly removable lid, and the hinged end of the case. The convenience of this portable indicator is further enhanced by the 15-inch leads supplied with it, which make it possible to use the electrodes outside of the case.

For a copy of Catalog E-96(3), "Portable Universal pH Indicator", write to the manufacturers.

Plastic Safety Road Markers

Far-Lin Company
Burlington, N. J.

These new markers are made of a special white plastic, hardened under hydraulic pressure. The manufacturers say they will actually bleach whiter and whiter with age and under wear retain a skid-proof surface. They wear down as the road surface wears. They offer no resistance to road scrapers and the method of sealing edges after installation insures against water seeping into the road base. The ease of installation is an important feature. It can be done by the maintenance gang with simple tools which can be rented from the Far-Lin Company at a nominal charge. It is claimed that once installed they become a permanent part of the road.

Handbook of Blueprint-Making and Processing

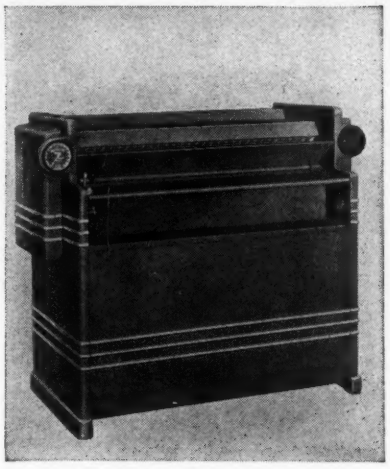
The Paragon-Revolute Corporation
77 South Avenue, Rochester 4, N. Y.

In this handbook No. PW, H. H. Sullivan, president, describes the processes to which the various types of prints are most adaptable and the methods by which they may be obtained.

In the opening sections of the book the four generally used methods of print-making are discussed. These include Blueprints and Blueline Prints, Sepia Negatives and Brownline Prints, Direct Process Prints or Whiteprints, and Reproduced Tracings.

Blueprints, the most commonly used reproduction, are discussed as to different methods of producing them for various volume requirements.

The book will be of great value to those requiring blueprints and copies of drawings.



Revolute 8Q Printer—A Fast, compact, economical, easy-to-operate printer which will expose blueprints, direct process pirnts, and sepia negatives up to 54" wide at speeds ranging from 6" to 32 lineal feet per minute.

Included in the Handbook PW is a description of the new Revolute 8Q Printer for those desirous of a fast, compact, economical, easy-to-operate printer. It is designed to meet the requirements of those whose print production has graduated from small to the intermediate stage. It occupies small floor space, will expose Blueprints, direct process prints, and sepia negatives up to 54" wide. Speeds range from 6" to 32 lineal feet per minute. It incorporates revolving contact and uses a quartz high pressure mercury vapor lamp, drawing approximately 75 watts per lineal inch.

Another section of the Handbook PW is devoted to reproduced tracings, the demand for which is directly attributable to the war. For such work the new Revolute 8F Continuous Copier is recommended.

Copies of Handbook PW will be sent upon request.

New Type All-Purpose "Protectioneered" Motor

Fairbanks, Morse & Co.
600 South Michigan Ave., Chicago, Ill.

Following months of research and practical operation in the field, Fairbanks-Morse has announced a New type, All-Purpose, Continuous-Duty, Polyphase Squirrel-Cage Induction Motor for use in all kinds of industry.

The company says this new motor is "protectioneered" and constructed with the widely recognized and exclusive centrifugally-cast F-M Copperspun Rotor and is fully protected against flying chips, falling particles, dripping liquids, and other industrial motor hazards. The ball bearings sealed in cartridge-type housings minimize expensive shut-downs due to bearing failures. Cross-flow ventilation, a feature in frames 224 to 365 inclusive, is obtained through protected inlets and exhausts at each end of the motor—resulting in uniform cooling and the elimination of hot spots.

Regardless of the position of the motor, complete safety for the operator is assured because there are no moving external parts. The frame is cast in one piece with rib sections to give added strength without increase in weight.

The new motor also incorporates an innovation in

As more materials are diverted to essential war uses, new equipment becomes more difficult to get. Greater care must be given present equipment until after Victory. Let your Gorman-Rupp distributor restore your equipment to its original operating efficiency. They carry parts and repairs for all equipment they sell. Their charges will be reasonable.

Gorman-Rupp Self-Priming Centrifugal Pumps are available for immediate delivery through Gorman-Rupp Distributors.

THE GORMAN-RUPP CO. Mansfield, Ohio

Place High on your Equipment Requisition

National Carbide FLOODLIGHTS

HAVE THEM READY

for Any Emergency
for Future Projects

Simple in Construction.
Economical in Cost.
Dependable in Operation.

Available in 1500, 8000 and 16,000 candlepower units.

Write for literature showing complete lines of Floodlights and Lanterns.

NATIONAL CARBIDE CORPORATION

NC-200 **60 E. 42ND STREET, NEW YORK 17, N. Y.**

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FITS YOUR NEEDS

for RECORDS and DEEDS

City and county officials find A-PE-CO a fast, accurate, low-cost legal means of copying official documents, records and vital statistics . . . copies from books made without removing or harming pages. Engineers prefer A-PE-CO for copying blueprints.

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Same-size copies of anything up to 18"x 22". Accepted as legal evidence. Eliminates steno-copying, tracing, proof-reading. Photo-copies direct from blueprints, graphs, tracings, telegrams, receipts, shop orders — anything written, printed, drawn, photographed. Endless uses for A-PE-CO. Needed by *all* departments. Big savings. Thousands in satisfactory use.

No Camera—No Film—Easy to Use

Simple, fast. No focusing. Conserves man-hours. Any office employee quickly becomes expert. Low cost per copy, lowest investment in equipment. Saves other equipment. Put A-PE-CO on any available desk or table. Immediate delivery. Representatives in principal cities and Canada. Write for A-PE-CO folder.

AMERICAN PHOTOCOPY EQUIPMENT CO.
2849 N. Clark St. Dept. GY-10 Chicago 14, Illinois

CUT MAINTENANCE COSTS 75%

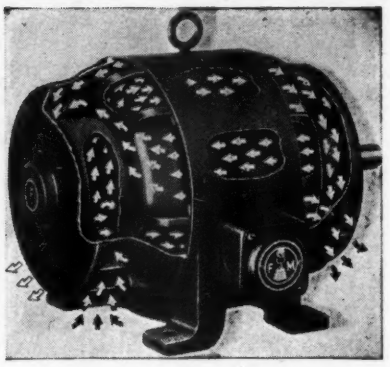
Concrete slab maintenance costs can be reduced as much as 75% by the Koehring Mud-Jack Method. The Mud-Jack raises sunken concrete walks, curbs and gutters, driveways, streets, and airport runways eliminating reconstruction costs. Write for the new Mud-Jack Bulletin which is both illustrative and descriptive.

KOEHRING HEAVY DUTY

KOEHRING COMPANY
Milwaukee, Wisconsin

MUD-JACK METHOD

When writing, we will appreciate your mentioning **PUBLIC WORKS**

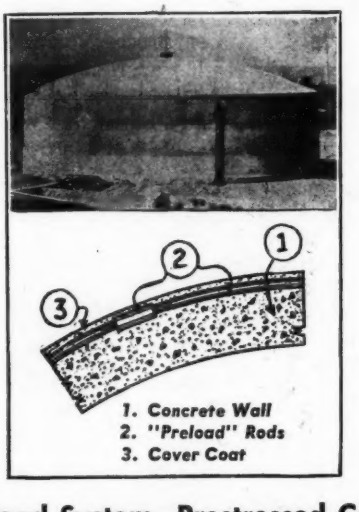


Fairbanks-Morse squirrel-cage induction motor.

conduit boxes. Where space is limited, the conduit can be brought up between the motor feet to the tapped hole in the motor frame and the conduit box cover assembled flush with the frame. The external box is then discarded. When the conventional conduit box is used it can be mounted in any one of four positions.

It is rated 40° C. and designed to carry 115% load continuously without injurious heating (1.15% service factor).

Complete information and motor demonstration can be obtained by writing the manufacturers for Bulletin #1160 which features this new F-M motor.



The Preload System—Prestressed Concrete Construction

The Preload Company
420 Lexington Ave., New York

The system is described by the company as: a system of reinforced concrete construction involving a different relation between steel and concrete. In the case of a tank steel bands are tensioned around a concrete shell similarly to their use in wood stave construction. The tensioning of the bands compresses the concrete as wood staves are compressed. The filling of the tank elongates the shell and slightly increases the tension in the bands. The important result however has to do with the concrete. Instead of being tensioned in conjunction with the steel as the tank is filled it releases compression. This is the feature of the Preload System and the basis of its success. Without tension concrete does not crack. Liquid tightness and permanence are thus accomplished.

In the walls of the conventional concrete water tank, water fills the minute cracks and freezes during cold weather. The expansion of the ice gradually

breaks down the concrete and the walls soon become unsightly and ineffective. In an attempt to offset this it is usual to design the walls to be exceptionally heavy. Sometimes the thickness is thirty-six inches or more while the floor, having the greatest head, may have a thickness under six inches. This would be entirely inconsistent were it not for the factors cited in the previous paragraph.

The walls of a Preload Tank need be no thicker than the floor except for the requirements of Prestressing. Prestressing is also applied vertically to prevent horizontal cracking which would occur due to temperature differences and shrinkage. Release of compression in place of tension is the answer. Preload walls neither crack nor leak and are permanent.

A folder describing and illustrating the Preload System will be sent on request.

Need for Air-Borne Tractor Shovels Makes Plant Increase a Necessity

Hough air-borne tractor shovels are proving so valuable to the war effort on beaches and fighting fronts that in order to meet increased government orders, it has been necessary to triple the size of the buildings and production facilities of the Frank G. Hough Co.'s No. 1 plant at Libertyville, Illinois, C. E. Killebrew, sales manager, announces. The air-borne shovel is small, rugged and compact, and can be easily stowed away on a transport plane from which it emerges all ready to get to work. This piece of earth moving equipment was especially designed for air transportation.

Another war-time application of Hough equipment is the use of tractor powered brooms of various sizes in maintaining airports and landing strips, Mr. Killebrew points out.

Construction Specifications, a 260-Page Book Published by

The Asphalt Institute
801 Second Ave., New York, N. Y.

The Institute states: "The specifications are designed to provide only broad, general standards of acceptable methods and materials for assuring completely satisfactory construction results. They are not intended for specific jobs, but to serve as guides in developing more detailed specifications having narrower limits of tolerance than is desirable in general specifications." Table of contents: Surface Treatment, Road-Mix, Penetration Macadam, Cold-Laid Plant-Mix, Hot-Laid Plant-Mix Surfaces, Base Courses, Cold-Patch, Asphalt Block Pavement.

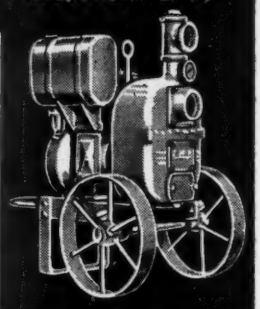
If you haven't a copy of this volume, write the Institute.

Safe Top Fire Hydrants

Kennedy Valve Mfg. Co.
Elmira, N. Y.

Water department superintendents, fire chiefs, and municipal officials will be interested in a new folder describing the Kennedy SAFETOP Fire Hydrant which has just been published. The folder concisely outlines this design, which has been characterized by some water department men as "the greatest advance ever made in fire hydrant design." Sectional views show the construction of the entire hydrant, with an enlarged illustration of the Safety Breakable Section which can be replaced within half an hour if the

C. H. & E. CONSTRUCTION EQUIPMENT



SELF-PRIMING CENTRIFUGAL PUMPS

Complete line of efficient, dependable low cost pumping units, built in sizes 3000 to 125,000 gallons per hour. Non-clog impeller, large pump case for quick positive automatic priming.

Write for Bulletin
3841 N. PALMER STREET

SAW RIGS · PUMPS · HOISTS · MORTAR MIXERS · TANDEM ROLLERS · BAR BENDERS · BAR CUTTERS

C. H. & E. Manufacturing Co.
Milwaukee, Wis.

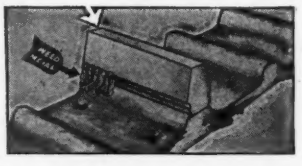
Rebuild your
TRACTOR GROUSERS WITH BULLDOG Grip-Lugs

Increases Traction Efficiency

A QUICK AND ECONOMICAL REPAIR

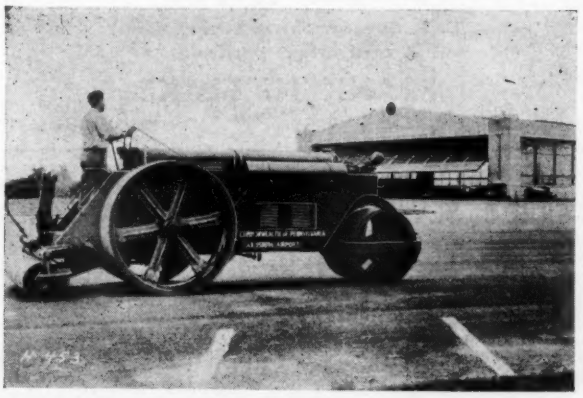
EASILY WELDED

Send for Bulletin PW-7



ALLIED STEEL PRODUCTS, INC.
N.B.C. BLDG.
CLEVELAND 14 OHIO

TAKE GOOD CARE OF YOUR



HERCULES ROAD ROLLERS

Keep 'em clean, adjusted, lubricated and repaired! Send for free Booklet H—3713, "Operation and Care of Hercules Rollers."

Also contact Hercules Distributors for good service

THE HERCULES COMPANY
MARION — OHIO

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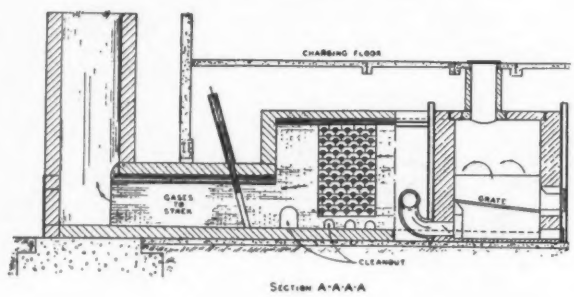
"FITCH"

RECUPERATORS

FOR

INCINERATORS



SECTION A-A-A-A

AN INCINERATOR necessity is a good recuperator. "Fitch" Recuperators combine Thermal Conductivity, Great Strength and Accessibility.

Write for Bulletin No. 11

"RECUPERATORS FOR INCINERATORS"

FITCH RECUPERATOR CO.

PLAINFIELD **NEW JERSEY**

Combined

SEWER AND PIPE FINDER

WITH AMPLIFYING RECEIVING COIL

(U. S. Government is buying them)

A card brings particulars

FRANK N. BLAKE

NORTH ADAMS **MASSACHUSETTS**

STREET, SEWER AND WATER CASTINGS

Made from wear-resisting chilled iron in various styles, sizes and weights.

MANHOLE COVERS, WATER METER COVERS, ADJUSTABLE CURB INLETS, GUTTER CROSSING PLATES, VALVE AND LAMPHOLE COVERS

Write for Catalog and Prices

SOUTH BEND FOUNDRY CO.

Gray Iron and Semi-Steel Castings

SOUTH BEND, IND.

Announcing—

1943 MANUAL OF

SEWAGE DISPOSAL EQUIPMENT

AND SEWER CONSTRUCTION

Published This Month

PUBLIC WORKS Magazine, 310 E. 45th St., New York 17, N. Y.

***When writing, we will appreciate your mentioning* PUBLIC WORKS**

hydrant is struck in smashing collision. A complete parts list and dimensions are also included. Copies of the folder can be obtained by writing The Kennedy Valve Mfg. Co., and asking for Bulletin 62.

Var-I-Feeder

Chem-Feeds, Inc.
77 Reservoir Ave., Providence, R. I.

Among detailed information on this new chemical feeder published in an 8-page well illustrated folder, the manufacturer says Var-I-Feeder introduces a new application of control in chemical measurement—no need to stop for adjusting quantities; control scale indicates gallons fed per hour; lbs. of chlorine per hour, gallons per hour pumpage being treated, on three illuminated scales for standard waters.

The mechanism occupies about a cubic foot. The complete outfit with accessories weighs 57 lbs.

Power—electric motor 1/20 H.P., a gas engine or a belt connected to an available R.P.M. (such as a revolving pump shaft).

Write for a copy of bulletin 77.

Portable Air Compressor

Davey Compressor Co.
Kent, Ohio

In a 30-page catalog descriptions and illustrations are published of this company's full line of portable Air Compressors. Special emphasis is given to the Davey Air Aristocrat—spring mounted, with fluid drive, full force feed lubrication, oil filter and air cleaner protection, are standard features. It is offered in 6 mounting styles with gasoline or diesel power. Other models suitable for any air compressor purpose are included.

Overhead Handling Equipment

The American Monorail Co.
Athens and Halstead Aves., Cleveland 7, Ohio

In a new 60-page, profusely illustrated catalog this outstanding manufacturer of material handling equipment describes the development and improvement of equipment based upon solutions of such problems. The American Monorail equipment is installed in numerous sewage disposal plants for handling sludge and in water treatment plants for conveying materials. The company offers the services of its trained engineers who are often able to reveal hidden possibilities for profitable applications of Overhead Handling Equipment. Consultation is available without obligation.

How to Install Flowmeters and Keep Them Accurate

Cochrane Corporation
17th and Allegheny Ave., Philadelphia 32, Pa.

In an 8-page Manual William C. Bennett of this company tells how to install Flowmeters and keep them accurate to the end that the charts may do a 100% job for today's War and tomorrow's Peace. Write for a copy.

Electronic Level Controls

Photoswitch, Inc.
77 Broadway, Cambridge 42, Massachusetts

In this folder descriptions are published of electronic level controls which are available for single level indication and control, on and off pump control

at two levels, boiler feed water control, and tank condensate signals. Illustrations are shown and operation described. If you are interested in level controls, write for a copy of this folder.

Calcium Chloride Association Appoints Engineer on Concrete Construction

H. Hershey Miller has been engaged as an engineer representative of the Calcium Chloride Association, with assignment especially as counsellor on concreting.

For many years he was Chief Materials Engineer for the Pennsylvania Department of Highways and later Testing Engineer for the Pennsylvania Turnpike Commission. For the past three years he has been resident engineer of the Pennsylvania Sand and Gravel Producers' Association.

Mr. Miller is author of a number of articles on concrete problems and has served on committees of the Highway Research Board, American Society for Testing Materials and Pennsylvania Society of Professional Engineers and, at present, is president of the Engineers Society of Pennsylvania.

Johns-Manville Promotes E. A. Phoenix

The appointment of E. A. Phoenix as Assistant Manager of the Transite Asbestos Pipe Department of Johns-Manville was announced this week by T. K. Mial, Vice President in charge of industrial sales.

Mr. Phoenix began his business career with the Kieselguhr Company of America in 1915. This firm later became The Celite Products Company which became part of Johns-Manville Corporation in 1928. After serving in various sales and advertising positions, Mr. Phoenix was made Assistant Sales Promotion Manager in April, 1936. In May, 1942, because of his knowledge of the company's widely diversified product lines, he was transferred to the Priorities Department, a position which he held until his recent promotion.

In 1940, Mr. Phoenix became a member of the Johns-Manville Quarter Century Club, an honorary organization composed of those who have been with the company 25 years or more.

Mr. Phoenix will serve as general assistant to Mr. C. A. McGinnis, Manager of the Transite Pipe Department, and will specialize in field sales and educational phases of the business.

Employees in Armed Services to Get Photos of "Home Folks" as Christmas Gift

A photo of "Mom and Dad" in a convenient carrying case will be the highly personal Christmas gift going to employees of Wallace & Tiernan Co., Inc., who are now in the armed services.

Already, a letter has been sent to the family of each such employee, telling of arrangements to have a studio portrait taken of the parents, or any other two members of the family, without charge. Appointments are being scheduled at the studio of a local photographer so that all portraits can be taken in time to meet the October 15th deadline for foreign Christmas mail.

Accompanying the letter to families of the 405 W & T service men, the War Efforts Committee of Wallace & Tiernan enclosed a reproduction of a sample photograph—"to show how these pictures will look." This "sample" showed Mr. and Mrs. M. F. Tiernan, who themselves have two sons in service.

SterElators by Everson

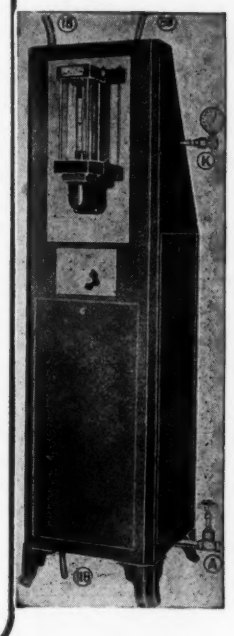
Astonishingly
Accurate in metering chlorine.

Astonishing
Capacity range —ratios up to 1 to 110.

Astonishingly
Easy to operate.

Safe . . .
Protected by automatic shut-off, vents and siphon breaks.

Write . . .
for Bulletin.



EVERSON MANUFACTURING COMPANY
237 W. HURON ST. CHICAGO, 6, ILL.

HEAVY-DUTY INCINERATION
MORSE BOULGER DESTRUCTORS
FOR THE
INCINERATION OF MUNICIPAL WASTES
GARBAGE, RUBBISH, SEWAGE SCREENINGS AND SLUDGE
FOR COMPLETE INFORMATION CALL OR WRITE
MORSE BOULGER DESTRUCTOR CO.
HOME OFFICE: 216-P East 45th St., New York, N. Y.

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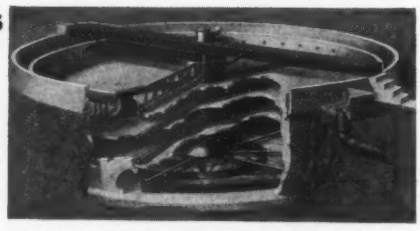
CONTINENTAL
HANNA BUILDING, CLEVELAND, OHIO

One of the most distinguished Restaurants between New York and Chicago

THE NATURAL MEETING PLACE FOR MIDWESTERN BUSINESS MEN

40 Years of
WATER PURIFICATION
FOR MORE THAN FORTY YEARS
We have specialized in the art of water purification. We manufacture a full line of Water Filters both pressure and gravity types. Zeolite Water Softeners. Swimming Pool Recirculating Equipment and various forms of Water Rectification Units. Inquiries are invited on all problems of water treatment
ROBERTS FILTER MFG. CO.
640 COLUMBIA AVE. DARBY, PA.

P.F.T. Clarifiers for Rapid Precipitation of Sewage Solids



The P.F.T. Tray Clarifier embodies a design which effects the continuous rapid separation of the solids and liquid in sewage; and the immediate removal of the clarified effluent. A series of shallow settling areas over which the sewage is spread assures speedy precipitation. Its high rate of flow provides maximum capacity in minimum space; reducing the construction and operating costs of clarification equipment.
Write for Bulletin No. 210 containing complete information, including operating results.

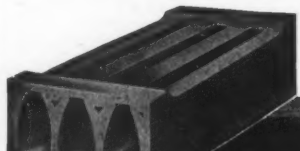
P.F.T. PACIFIC FLUSH-TANK CO.
4241 Ravenswood Ave., Chicago, Ill.
NEW YORK—CHARLOTTE, N. C.

STILL IN THE PICTURE!

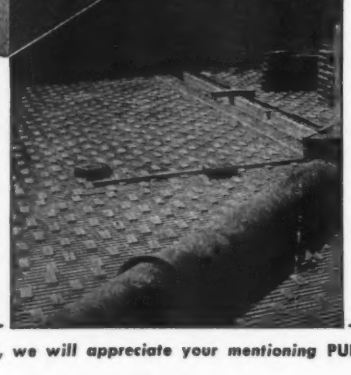
WITH WESTON GASKETS and FORMS for ALL SEWER PIPE JOINTS

Minimizes infiltration, exfiltration and root intrusion. Although on curtailed production, due to shortage of materials and labor, we can still supply some of you and will welcome your inquiries now.

L. A. WESTON, ADAMS, MASS.



NATCO UNIFILTER TILE FOR TRICKLING FILTER SYSTEMS



One piece underdrain
Egg-shaped run-off
Rapid, complete ventilation
Salt glazed surfaces

Write for literature on Natco glazed segmentile for corrosion resistant walls of circular filter beds

NATIONAL FIREPROOFING CORP.
PITTSBURGH PA.

When writing, we will appreciate your mentioning PUBLIC WORKS

As part of the W & T War Efforts Committee activities, a Servicemen's-10¢-a-Week Club has been formed. All money collected from the members of this Club is used to purchase gifts for W & T men in the service, and the photograph of "Mom and Dad" is their idea of the most welcome Christmas present for each serviceman.

Cletrac Receives Army-Navy "E" Award

For excellence in production and outstanding production achievement, the personnel of The Cleveland Tractor Company, of Cleveland, Ohio, was awarded the Army-Navy "E' at a colorful and impressive ceremony.

The award was conferred in recognition of the company's noteworthy contribution to the war effort, not only in the development and production of specialized crawler tractors built for the Air Corps, but for outstanding production of its standard product as well as the parts for tanks, Bofor anti-aircraft gun, and half-trac cars.

The presentation of the "E" award was made by Lt.-Col. T. H. Eichoff and received by Mr. L. H. Grutsch, Works Manager, and Mr. V. O'Neal, representing the employees.

The "E" pins were presented by Lt. Commander J. P. Sturgis of the U. S. Naval Reserves, assisted by Sgt. Arthur E. Sizer, U. S. Army, a veteran of the African campaign, and accepted by a group of five of the oldest employees of The Cleveland Tractor Company.

Victory Scrap Bank Drive

The "Victory Scrap Bank" drive is a national "all-out" campaign for iron and steel scrap. Although heavier grades of scrap, from farm and industrial sources, primarily are desired, all types and grades of scrap will be accepted.

The drive will extend from October 1st to November 15th, 1943. The drive has been officially announced by Donald M. Nelson, Chairman of the War Production Board, and endorsed by leading representatives of the Steel Industry and scrap dealers throughout the country.

Each community will have its own scrap stock pile, or "Victory Scrap Bank." The general public should be urged to regard these Banks as sources of "metallurgical blood plasma," guaranteeing a continuing flow of vital war armaments so urgently needed for the successful continuation of our military ventures abroad.

The drive will be participated in by every community in the United States, working through the channels of their local Salvage Committees. School children throughout the nation will be marshalled together for the drive, through the direction of their local schools.

The council of State Governments, including the governors of every state, and extending down into the various state subdivisions, will help in the direction of the drive, and cooperate to the fullest extent with the local, state and regional salvage organizations.

Every bit of scrap turned in will be properly handled. Representatives of steel companies have stated that they would increase their inventories, thereby making it possible for the scrap dealers to move the newly collected scrap into their yards for proper preparation. Also, a working agreement between the government and the steel industry, already in operation, will insure a ready market for every pound of steel collected.

Readers' Service Department

These booklets are FREE but distribution is restricted to those actively engaged in engineering or construction. Use the coupon below or write the manufacturer direct, mentioning PUBLIC WORKS.

Construction Materials and Equipment

Air Raid Shelters

3. New 8 page booklet pictures and describes a corrugated pipe shelter with gas tight end walls, emergency escape tunnel and other desirable features. Armco Drainage Products Assn., Middletown, Ohio.

Bridges

7. Teco Connectors, a new method of structural engineering, to spread the load on a timber joint more equally over the cross-section of the wood is described in new literature available from Timber Engineering Co., Dept. BS-2, 1319—18th St., N. W., Washington, D. C.

Cement Dispersion

9. "Economics of Cement Dispersion and Pozzolith" tells the complete story of how cement dispersion reduces water required up to 20% and increases workability 150%. Write The Master Builders Co., Cleveland, Ohio, for a copy.

Cold Mix Plants

15. New catalogs and prices of Portable Bituminous Mixers in 6 to 14 ft. sizes for resurfacing and maintenance. Issued by The Jaeger Machine Co., 400 Dublin Ave., Columbus 16, Ohio.

Cold or Wet Weather Construction

18. Cleaver Aggregate Heaters and Dryers, Hot Water Boosters, and Automatic Steam plants are designed to speed up cold or wet weather construction. Write for illustrated bulletins. Cleaver-Brooks Co., 3112 W. Center St., Milwaukee, Wis.

Concrete

20. "Concrete—How Many Factors of Safety Does It Need?" is title of new illustrated, informative booklet describing precision control for concreting. Scientific Concrete Service Corporation, McLachlen Bldg., Washington, D. C.

Concrete Accelerators

31. New 48-page booklet in five sections explains clearly the effects, advantages and methods of using Calcium Chloride and Portland Cement mixes. Complete and packed with practical information; well illustrated; pocket size. Sent free on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

Concrete Curing

33. 64-page manual of concrete curing with calcium chlorides. Complete, handy. Contains useful tables, well illustrated. Write the Columbia Chemical Division, Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa.

Concrete, Early Strength

38. 64-page manual tells how to speed up year 'round concreting, shows how to secure high early strength and greater workability at temperatures either below or above freezing. Contains many actual examples of practical concreting operations; well illustrated with more than 60 photos, charts, graphs and tables. Calcium Chloride Assn., Penobscot Building, Detroit 26, Mich.

Concrete Mixers

44. Catalog and prices of Concrete Mixers, both Tilting and Non-Tilt types, from 3½S to 56S sizes. The Jaeger Machine Company, 400 Dublin Ave., Columbus 16, Ohio.

Copying Machines

50. The A-PE-CO photo-copyer which makes non-fading copies direct from drawings, blueprints, records, letters, etc., in any size up to 18" x 22" is described in new illustrated folder. Write American Photocopy Equipment Co., Dept. GY-10, 2849 No. Clark St., Chicago 14, Ill.

Drainage Products

70. Standard corrugated pipe, perforated pipe and MULTI PLATE pipe and arches — for culverts, sewers, subdrains, cattlepasses and other uses are described in a 48-page catalog entitled "ARMCO Drainage Products," issued by the Armco Drainage Products Association, Middletown, Ohio, and its associated member companies. Ask for Catalog No. 12.

Forms, Steel

90. Steel forms for Highways, Sidewalks and Airports, to keep pace with ever changing conditions are covered in two new bulletins containing complete specifications. Write Heltzel Steel Form & Iron Co., Warren, Ohio.

Graders, Patrol

105. The Austin-Western 99M Power Grader with its powerful all wheel drive simplifies all construction and maintenance; handles difficult jobs with economy and efficiency; and does better work on grading, ditching, scarifying, snow plowing, loading, mixing, bulldozing, shoulder trenching and backsloping. Write for Bulletin 1946. Austin-Western Road Machinery Co., Aurora, Ill.

Mixing Plants, Asphalt

106. The Cleaver Asphalt Mixing Plant for an inexpensive plant mix and the Cleaver Tank Car Heater and Bituminous Booster are covered in illustrated catalogs sent on request by Cleaver-Brooks Co., 3112 W. Center St., Milwaukee, Wis.

Mud-Jack Method

107. How the Mud Jack Method for raising concrete curb, gutter, walls and street solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities — a new bulletin by Koehring Company, 3026 West Concordia Ave., Milwaukee, Wis.

Oil, Motor

109. "Here's Proof of Ring-Free Superiority," 32 pages, illustrated, outlines the principles of lubrication and explains how by simple tests you can measure the advantages of Macmillan Ring-Free Motor Oil. Write Macmillan Petroleum Corp., 530 West 6th St., Los Angeles, Calif.

Paving Materials, Bituminous

111. New "Tarvia Manual" is packed with useful data on how to build and maintain roads with Tarvia. Each step is illustrated with excellent action pictures, 64 pp. 103 ills. Write to The Barrett Div., 40 Rector St., New York, N. Y.

Pumps

120. Interesting new booklet tells how to lengthen the life of your pumps. Explains how a little care will save a lot of wear. Write today for your copy. Homelite Corp., 2403 Riverdale Ave., Portchester, N. Y.

121. New illustrated catalog and prices of Jaeger Sure Prime Pumps, 2" to 10" sizes, 7000 to 220,000 G.P.H. capacities, also Jetting, Caisson, Road Pumps, recently issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus 16, Ohio.

123. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

124. 16-page illustrated bulletin, SP-37, describes and illustrates complete C. H. & E. line of self-priming centrifugal pumps from ½" to 8", including lightweight models for easy portability. C. H. & E. Mfg. Co., 3841 No. Palmer St., Milwaukee, Wis.

Road Building and Maintenance

128. Motor Patrol Graders for road maintenance, road widening and road building, a complete line offering choice of weight, power, final drive and special equipment to exactly fit the job. Action pictures and full details are in catalogs Nos. 253, 254 & 255, issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

Rock Drill Maintenance

130. New booklet presents through amusing cartoons useful hints on proper rock drill maintenance methods—what your men can do to get more work out of your tools with a minimum of expense for repairs and compressed air. Write The Cleveland Rock Drill Co., 3734 East 78th St., Cleveland, Ohio.

Rollers

133. New Tu-Ton roller of simple construction for use in rolling sidewalks along highways, playgrounds and other types of light rolling is fully described in a bulletin issued by C. H. & E. Mfg. Co., 3841 No. Palmer St., Milwaukee, Wis.

138. "The Buffalo-Springfield line of road rollers (tandem, 3-wheel, and 3-axle) are described in the latest catalog issued by the Buffalo-Springfield Roller Co., Springfield, Ohio."

139. "Ironeroller" 3 Axle Roller for extra smooth surfaces on all bituminous work. Booklet contains roller data and operation details. Hercules Co., Marion, Ohio.

140. This well-illustrated 16-page catalog describes the tandem, autocrat, cadet, and roll-a-plane rollers, and explains what each is intended to accomplish. Write Austin-Western Road Mach. Co., Aurora, Ill.

Rotproofing

145. Cuprinol, a rotproofing chemical that protects wood from fungi and insects, yet has no offensive odor, is non-poisonous, does not corrode metal and can be painted over. Get full details in booklet from Cuprinol, Inc., 7 Water St., Boston, Mass.

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Soil Stabilization

150. "High-Service, Low Cost Roads" is one of the newer booklets using an effective combination of picture and text to set forth the principles and advantages of road surface stabilization with calcium chloride. Complete, interesting and well illustrated. 34 pages. Sent by Solvay Sales Corp., 40 Rector St., New York, N. Y.

152. The Columbia Chemical Division will be glad to furnish to anyone interested complete information dealing with Calcium Chloride Stabilized Roads. This literature contains many charts, tables and useful information and can be obtained by writing Columbia Chemical Div., Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa.

154. "Soil Stabilization with Tarvia"—An illustrated booklet describing The steps in the stabilization of roadway soil with Tarvia will be mailed on request by The Barrett Div., 40 Rector St., New York, N. Y.

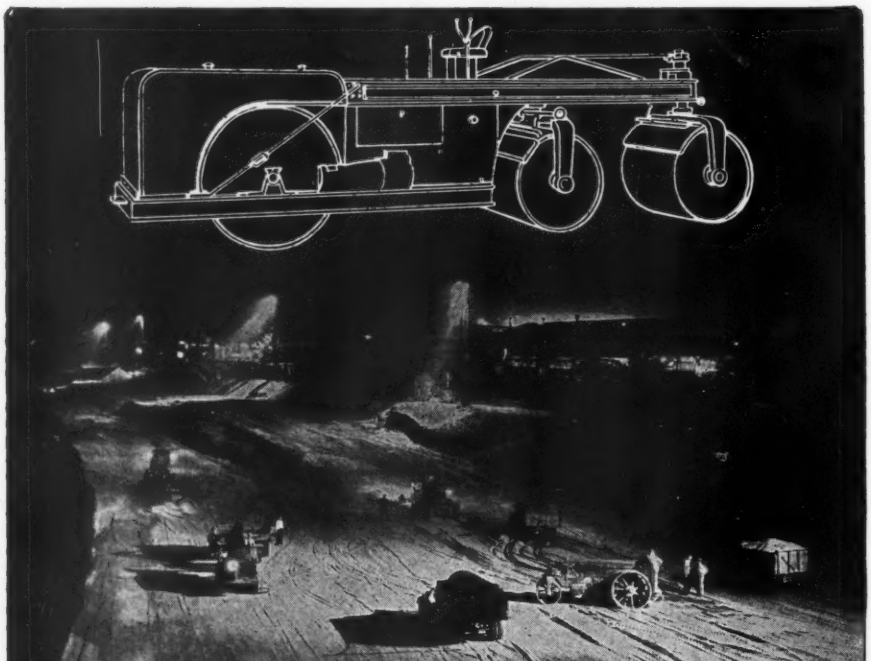
155. Sterling Rock Salt for Frost Damage Prevention. Sterling Rock Salt for Base and Surface Stabilization. Two descriptive bulletins issued by International Salt Co. Inc., Scranton, Pa.

Spreader

187. Jaeger Paving equipment, including Mix-in-Place Roadbuilders, Bituminous Pavers, Concrete Bituminous Finishers, Adjustable Spreaders, Forms, etc.—4 complete catalogs of latest equipment in one cover, issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus 16, Ohio.

Surface Consolidation and Maintenance

188. Detailed and illustrated presentation of the method and procedure in consolidated operations; explains how sub-soils can be conditioned to resist softening and frost action; how surfacing can be consolidated to provide smooth all-weather riding surfaces; how they can be maintained so as to prevent disintegration and gravel loss. Write the Calcium Chloride Association, Penobscot Bldg., Detroit 26, Mich., for Bulletin No. 29.



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189. "Typical Designs of Timber Structures" contains plans for 45 representative structures that have been engineered with Teco Connectors. For free copy write Timber Engineering Co., Inc., Room 6GG, 1319—18th St., N. W., Washington, D. C.

Wellpoints

195. New complete catalog, "Griffin Pointed Wellpoint Facts," just issued. Covers pre-drainage, describing wellpoints jetting pumps, with tables, diagrams and illustrations. Griffin Wellpoint Corp., 881 E. 141st St., New York.

Street and Paving Maintenance

290. "Blacktop Road Maintenance and Construction Equipment"—Asphalt and tar kettles, flue type kettles, spray attachments with completely submerged pumps, tool heaters, surface heaters, road brooms, portable trail-o-rollers, etc. These are all described in detail and illustrated. This modern and up-to-date equipment for blacktop airport and road construction and maintenance is based upon experience and engineering research over a period of 42 years. Write for Catalog R. Littleford Bros., Inc., 452 East Pearl St., Cincinnati 2, O.

Fire Apparatus

300. Detailed information and advice about specially engineered Ward LaFrance apparatus will be sent on request. Ward LaFrance Div., Elmira, N. Y.

Snow Fighting

Snow Plows

350. "Frink One-Way Sno-Plows" is a four page catalog illustrating and describing 5 models of One-Way Blade Type Sno-Plows for motor trucks from 1½ up to 8 tons capacity. Interchangeable with V Sno-Plow. Features, specifications and method of attaching. Carl H. Frink, Mfr., Clayton, 1000 Islands, N. Y.

Ice Control

351. "Make Icy Highways Safe for Traffic"—a new bulletin by Michigan Alkali Div., Wyandotte Chemicals Corp., Wyandotte, Mich., tells how to use calcium chloride for modern ice control.

352. Ice Prevention on Highways, Streets, and Airport Runways with Sterling "Auger Action" Rock Salt. An illustrated bulletin issued by International Salt Co. Inc., Scranton, Pa.

Sanitary Engineering

Aero-Filter

356. "Results Produced by Aero-Filters" is a new pamphlet covering results at Temple, Texas; Paris, Ill.; Webster City, Iowa; and Mason, Mich. Write Lakeside Engineering Corp., 222 West Adams St., Chicago, Ill.

Air Release Valves

357. Automatic Air Release Valves for water, sewage and industrial uses are described and illustrated in new catalog issued by Simplex Valve & Meter Co., 6750 Upland St., Philadelphia, Pa.

Analysis of Water

360. "Methods of Analyzing Water for Municipal and Industrial Use" is an excellent 94 page booklet with many useful tables and formulas. Sent on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

Activation and Aeration

367. A valuable booklet on porous diffuser plates and tubes for sewage treatment plants. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability. 20 pp. illustrated. Sent on request to Norton Company, Worcester, Mass.

Blowers

370. All interested in low cost air for sewage disposal will want a copy of this catalog describing operating principles and specifications of Roots-Connersville Aerating Blowers. Write to Roots-Connersville Blower Corp., 301 Valley Ave., Connersville, Ind.

Brine-Making Equipment

378. The Lixate Process for Making Brine. A 36-page fully-illustrated booklet on the Lixate Process for making brine. It gives all the facts—installations, brine tables, diagrams, formulas.—International Salt Co. Inc., Scranton, Pa.

Chlorinators, Portable

379. Complete data on new portable chlorinator designed to meet emergency calls quickly and efficiently. Write Wallace & Tiernan Co., Inc., Newark 1, N. J.

380. "Emergency Sterilization Equipment," a new bulletin describing the advantages of Dual Drive Chlor-O-Feeders which can serve as either a permanent chemical feeder or as a portable emergency chlorinator. Order from Proportioneers, Inc., 96 Codding St., Providence, R. I.

Cleaning Sewers With Own Forces

381. A 20-page booklet describes and illustrates a full line of sewer cleaning equipment—Rods, Root Cutters, Buckets, Nozzles and Flushers. Write W. H. Stewart (Pioneer Mfr. since 1901), Jacksonville, Fla., or P. O. Box 767, Syracuse, N. Y.

Cleaning Mains

383. 32-page illustrated booklet explains how a city can clean its sewers and culverts with its own forces using the up-to-date Flexible Sewer Rod equipment. Illustrates and describes all necessary equipment. Issued by Flexible Sewer Rod Equipment Co., 9059 Venice Boul., Los Angeles, Calif.

Consulting Engineers

384. "Who, What, Why" outlines briefly the functions of the consulting chemist and chemical engineer. Covers various methods of cooperation, on different types of problems, with industry, with attorneys and with individuals. Foster D. Snell, Inc., 305 Washington St., Brooklyn, N. Y., will send a copy on request.

Feeders, Chlorine, Amonia and Chemical

385. For chlorinating water supplies, sewage plants, swimming pools and feeding practically any chemical used in sanitation treatment of water and sewage. Flow of water controls dosage of chemical, reagent feed is immediately adjustable. Starts and stops automatically. Literature from % Proportioneers, Inc. % 96 Codding St., Providence, R. I.

386. New circular describes and illustrates the Var-I-Feeder, a new portable chemical feeder for water main sterilization, military use or other chemical treatment. Write Chem-Feeds, Inc., 77 Reservoir Ave., Providence, R. I.

387. Everson Sterelators for all kinds of chemical feeding in stationary and portable models are described in new bulletins issued by Everson Manufacturing Co., 214 West Huron St., Chicago 1, Ill.

Filters

388. How to increase the capacity of filters through use of Anthrafilt and complete data on use of Anthrafilt for filters and sludge beds is contained in a revised pocket Manual issued by Anthracite Equipment Corp. For free copy write H. G. Turner, State College, Pa.

Fire Hydrants

390. Specifications for standard AWWA fire hydrants with helpful instructions for ordering, installing, repairing, lengthening and using. Issued by M & H Valve & Fittings Co., Anniston, Ala.

391. See listing No. 410.

Flow Meters

392. The primary devices for flow measurement—the orifice, the pilot tube, the venturi meter and others—and the application to them of the Simplex meter are described in a useful 24-page booklet (42A). Simplex Valve and Meter Co., 6750 Upland St., Philadelphia, Pa.

Gas Holders and Digesters

393. Clarifiers, sludge digesters and other tanks and gas holders for sludge gas. Graver Tank & Mfg. Co., Inc., 332 So. Michigan Ave., Chicago, Ill.

Gates, Valves, Hydrants

394. Gate, flap and check valves; floor stands and fittings. New catalog No. 34 gives detail information with dimensions for all types of new full line. M. & H. Valve & Fittings Co., Anniston, Ala.

395. Complete booklet with much worthwhile water works data describes fully Ludlow hydrants and valves. Sent on request. Ludlow Valve Mfg. Co., Troy, N. Y.

396. See listing No. 410.

Gauges

398. The full line of Simplex gauges for filtration plants are illustrated and described in catalog issued by Simplex Valve and Meter Co., 6750 Upland St., Philadelphia, Pa.

Laboratory Equipment

403. pH and Chlorine Control. A discussion of pH control and description of comparators, chlorimeters and similar devices. An 80-page booklet. W. A. Taylor & Co., 7301 York Road, Baltimore, Md.

Maintenance

404. "The Lubriplate Way" contains much valuable information on long-lasting Lubriplate lubricants which are especially adapted for difficult conditions such as parts that are immersed in sewage, water or steam. Write Lubriplate Division of Fiske Brothers Refining Co., 129 Lockwood St., Newark, N. J.

Manhole Covers and Inlets

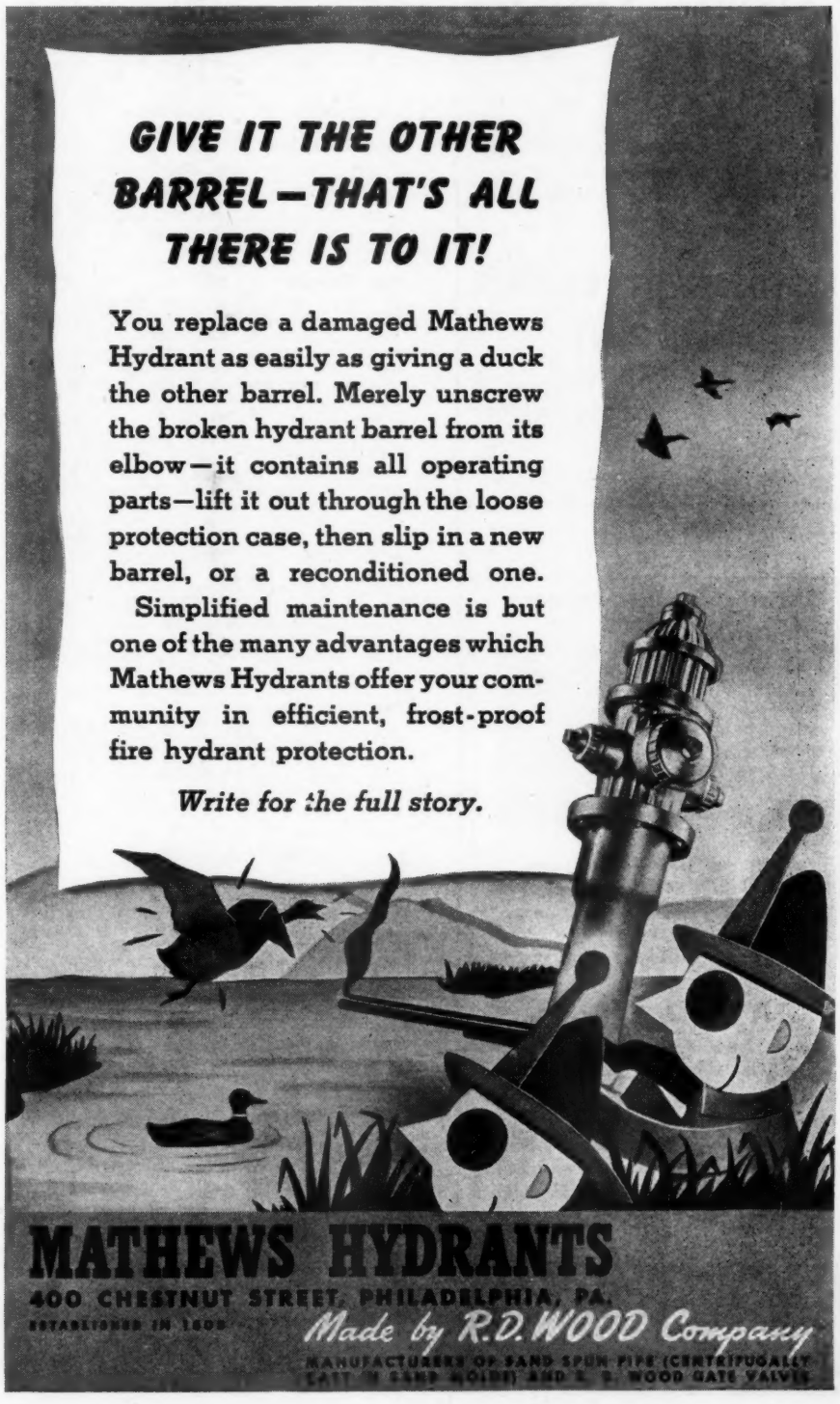
405. Street, sewer and water castings in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., Lafayette Boul. and Indiana Ave., South Bend, Ind.

Manhole Covers and Frames, Concrete

406. Detailed descriptive folder, with specifications, issued by United Concrete Form Products Co. Inc., 101 Park Ave., New York 17, N. Y.

Meters, Venturi

407. New bulletin illustrates Builders Air Relay system of transmission for the Venturi Meter which is particularly useful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for liquids containing suspended solids like sewage. Eliminates corroson, clogged pipes, etc. Write Builders-Providence, Inc., Codding St., Providence, R. I.

408. "The Selection of Main Line Meters," a highly informative and useful presentation prepared by a competent engineer, J. C. Thoresen, describes forms of differential producers and quickly solves typical problems with the use of graphic charts. Write Builders-Providence, Inc., 9 Codding St., Providence, R. I.

Pipe, Cast Iron

409. Handbook of Universal Cast Iron Pipe and Fittings, pocket size, 104 pages, illustrated, including 14 pages of useful reference tables and data. Sent by The Central Foundry Co., 386 Fourth Ave., New York 16, New York.

410. Cast iron pipe and fittings for water, gas, sewer and industrial service. Super-deLavaud centrifugally-cast and pit-cast pipe. Bell-and-spigot, U. S. Joint, flanged or flexible joints can be furnished to suit requirements. Write U. S. Pipe and Foundry Co., Burlington, N. J.

411. "Cast Iron Pipe and Fittings" is a well illustrated 44 page catalog giving full specifications for their complete line of Sand Spun Centrifugal Pipe, Fire Hydrants, Gate Valves, Special Castings, etc Will be sent promptly by R. D. Wood Co., 400 Chestnut St., Philadelphia, Pa

Pipe, Lock Joint

412. Lock Joint Reinforced Concrete Sewer Pipe. Pressure Pipe, Culvert Pipe, Centrifugal Pipe and Subaqueous Pipe is described and illustrated in bulletins available from Lock Joint Pipe Co., Ampere, N. J.

Pipe, Transite

414. Two new illustrated booklets "Transite Pressure Pipe" and "Transite Sewer Pipe" deal with methods of cutting costs of installation and maintenance of pipe lines and summarize advantages resulting from use of Transite pipes. Sent promptly by Johns-Manville Corp., 22 East 40th St., New York, N. Y.

Pipe Joints Sewer

415. How to make a better sewer pipe joint of cement—tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston, Adams, Mass.

Pipe, 2-inch Cast Iron

417. Generously illustrated booklet describes McWane 2-inch cast iron pipe and its manufacture in streamlined pipe shop. Write McWane Cast Iron Pipe Co., Birmingham 2, Ala.

Pipe Joint Compounds

418. The uses of Tegul-Mineralead for bell and spigot pipe and G-K Sewer joint compound are described in a 16-page illustrated booklet issued by Atlas Mineral Products Co., Mertztown, Pa. Includes useful tables for estimating quantities needed.

Pumps and Well Water Systems

420. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklets. Advertising Dept., Layne & Bowler, Inc., Box 186, Hollywood Station, Memphis, Tenn.

Pumps, Turbine

422. Oil lubricated turbine pumps with open impellers. Five types of heads available. Specifications and illustrations in new bulletin 6930M-2 issued by Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago, Ill.

Meter Setting and Testing

430. The most complete catalog we have seen on setting and testing equipment for water meters—exquisitely printed and illustrated 48-page booklet you should have a copy of. Ask Ford Meter Box Co., Wabash, Ind.

Screens

434. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straightline Bar Screens" (Vertical and Inclined types). Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.

Sludge Drying and Incineration

440. "Disposal of Municipal Refuse." Complete specifications and description including suggested form of proposal; form of guarantees; statements and approval sheet for comparing bids with diagramatic outline of various plant designs. 48 pages. Address: Morse Boulger Destructor Co., 216-P East 45th St., New York 17, N. Y.

442. Recuperator tubes made from Silicon Carbide and "Fireclay" Corebusters for maximum efficiency are described and illustrated in bulletin No. 11 issued by Fitch Recuperator Co., Plainfield National Bank Bldg., Plainfield, N. J.

443. Nichols Herreshoff incinerator for complete disposal of sewage solids and industrial wastes—a new booklet illustrates and explains how this Nichols incinerator works. Pictures recent installations. Write Nichols Engineering and Research Corp., 60 Wall Tower, New York, N. Y.

Softening

444. This folder explains the process of Zeolite water softening and describes and illustrates the full line of equipment for that purpose made by the Graver Tank & Mfg. Co., 332 So. Michigan Ave., Chicago, Ill. Includes flow charts, tables and other valuable data. Write for a copy of this instructive folder.

445. Water Softening. The use of the Spaulding Precipitator to obtain maximum efficiency and economy in water softening is described in a technical booklet. Permutit Co., 330 W. 42nd St., New York 18, N. Y.

Sprinkling Filters

447. Design data on sprinkling filters of Separate Nozzle Field and Common Nozzle Field design as well as complete data on single and twin dosing tanks, and the various siphons used in them, for apportioning sewage to nozzles. Many time-saving charts and tables. Write Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago 13, Ill.

Swimming Pools

448. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Taste and Odor Control

449. "Taste and Odor Control in Water Purification" is an excellent 32-page, illustrated booklet covering sources of taste and odor pollution in water supplies and outlining the various methods of treatment now in use. Every water works department should have a copy. Write Industrial Chemical Sales Div., 230 Park Ave., New York, N. Y.

450. Technical pub. No. 207 issued by Wallace & Tiernan Co., Inc., Newark 1, N. J., describes in detail taste and odor control of water with BREAK-POINT Chlorination, a method of discovering the point at which many causes of taste may be removed by chlorination with little or no increase in residual chlorine. Sent free to any operator requesting it.

453. "Safe Sanitation for a Nation," an interesting booklet containing thumbnail descriptions of the different pieces of P.F.T. equipment for sewage treatment. Includes photos of various installations and complete list of literature available from this company. Write Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago 13, Ill.

454. A full line of equipment for sewage disposal including clarifiers, chemical treatment plants, rotary distributors, gas holders and many other pieces of equipment are described in a new bulletin just issued by Graver Tank & Mfg. Co., 332 So. Michigan Ave., Chicago, Ill.

455. New booklet (No. 1642 on Link-Belt Circuline Collectors for Settling Tanks contains excellent pictures; drawings of installations, sanitary engineering data and design details. Link-Belt Company, 2045 W. Hunting Park Ave., Philadelphia.

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456. New 16-page illustrated catalog No. 1742 on Straightline Collectors for the efficient, continuous removal of sludge from rectangular tanks at sewerage and water plants. Contains layout drawings, installation pictures, and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia, Pa.

457. New illustrated folder (1942) on Straightline apparatus for the removal and washing of grit and detritus from rectangular grit chambers. Address: Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.

458. "Sedimentation with Dorr Clarifiers" is a complete 36-page illustrated catalog with useful design data. Ask The Dorr Company, 570 Lexington Ave., New York 22, N. Y.

459. A combination mechanical clarifier and mechanical digester, The Dorr Clarigester, is explained and illustrated in a bulletin issued by The Dorr Company, 570 Lexington Ave., New York 22, N. Y.

461. Preflocculation without chemicals with the Dorrco Clariflocculator in a single structure is the subject of a new booklet issued by The Dorr Company, 570 Lexington Ave., New York 22, N. Y.

462. Dorrco Monorake for existing rectangular sedimentation tanks, open or closed, is described and illustrated in a new catalog sent on request. The Dorr Co., 570 Lexington Ave., New York 22, N. Y.

465. Grit Washers and Collectors, by Jeffrey are built in three types: scraper, V-bucklet and combination. For full details ask for Jeffrey Catalog No. 703-A. Jeffrey Mfg. Co., 948-99 No. Fourth St., Columbus, Ohio.

466. Flocculation with Floctrols. For details on controlled flocculation, tapered mixing, practical elimination of short circuiting, rapid settling of properly flocculated solds write for Catalog No. 703-A. Jeffrey Mfg. Co., 948-99 No. Fourth St., Columbus, Ohio.

Underdrains, Trickling Filter

468. Illustrated bulletin describes the Natco Unifilter block of glazed, hard burned clay for underdraining filter beds. Write National Fireproofing Corp., Pittsburgh, Pa., for **free copy.**

Valves (See Gates, Air Release, etc.)

Waste Elimination

469. Full information on the Pitometer Survey—a complete check-up on your water plant to reveal hidden sources of waste—will be sent promptly by The Pitometer Co., 48 Church St., New York, N. Y.

Water Treatment

470. If you have a water conditioning problem of any kind, write Graver Tank & Mfg. Co., 332 So. Michigan Ave., Chicago, Ill., who manufacture all types of conditioning equipment and will be pleased to make recommendations.

Water Service Devices

500. Data on anti-freeze outdoor drinking fountains, hydrants, street washers, etc., will be sent promptly on request to Murdock Mfg. & Supply Co., 426 Plum St., Cincinnati, Ohio.

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WABASH, IND.

1943 Public Works Congress

Hotel Sherman, Chicago October 24, 25, 26, 27

TENTATIVE PROGRAM

SUNDAY, OCTOBER 24

Morning: Registration of Delegates. Meetings of Standing and Special Committees of APWA.

Afternoon: Open—Delegates may attend any of Chicago's regularly scheduled diversions. Advance suggestions: Ballet Russe at the Civic Opera; Professional Football Game—Chicago Bears vs. Brooklyn Dodgers at Wrigley Field. Meeting of the Board of Directors of APWA.

Evening: Get-acquainted hour. Informal buffet.

MONDAY, OCTOBER 25

Morning: Formal Opening of Congress. General Sessions: Essential Operation and Construction of Chicago's Public Works — Streets — Subways — Water Supply — Sewage Treatment; Wartime Maintenance of Streets and Highways; Reports of Committees.

Noon: Manpower Luncheon Conference—A discussion session dedicated to the study of this most important problem.

Afternoon: Special Tour of the Museum of Science and Industry—the outstanding exhibition of dynamic progress in the modern era.

TUESDAY, OCTOBER 26

Morning: Round Table Breakfasts—(1) Street and Highway Maintenance; (2) Employee Relations; (3) Advance Engineering Design and Long-Range Planning; (4) "Headache Session" (entirely off-the-record).

General Session—Wartime Problems in Congested Areas. Refuse Collection, Disposal and Salvage—A Symposium.

Afternoon: Sewerage Planning, Financing and Designing for the Post-War Period Airports and Airways in the Public Works Programs of the Future.

Evening: Annual APWA Dinner.

WEDNESDAY, OCTOBER 27

Morning: Round Table Breakfasts—(1) Refuse Collection and Disposal—Sidelights on Food Conservation; (2) Wartime Sewerage Practices — Sludge Utilization—Grease Salvage; (3) Airport Location and Design; (4) Street Cleaning and Snow Removal.

General Session; Planning for the Transition Period. The Place of City Planning in the Modern Municipal Structure. Programming Local Capital Improvements. State Planning of Public Works. The Integration of Long Range Works Programs.

Noon: Luncheon; Broad-gauge Planning for National Prosperity.

Afternoon: Special Business Session for all APWA Delegates. Meeting of the Board of Directors of APWA.

OTHER ASSOCIATION MEETINGS

October 15-16 — FOUR STATES SECTION A.W.W.A. annual meeting, Benjamin Franklin Hotel, Philadelphia.

October 21 - 23 — FEDERATION OF SEWAGE WORKS ASSOCIATION, Sherman Hotel, Chicago.

October 24-27—Streamlined American Public Works Association meeting will be held at Hotel Sherman, Chicago.

October 27 - 28 — CALIFORNIA SECTION A.W.W.A., Biltmore Hotel, Los Angeles.

November 1-3 — NORTH CAROLINA SECTION A.W.W.A., Winston-Salem, Hotel Robert E. Lee.

November 3-4—Annual Water Plant Operators Conference promoted by the Illinois Department of Public Health will be held at Leland Hotel, Springfield. As heretofore, the Operators Trophy will be awarded to the Outstanding Operator of the year.

NEW APPOINTMENTS

New City and County Officials recently reported:

City Engineers

Ulric F. Gray, Albany, Calif.
Frank R. Nohl, Richmond Heights, Mo.
Roy Neal, Perry, Okla.
George E. Yundt, Emmaus, Pa.

Public Works Superintendents

Weldon Oeffler, Jasonville, Ind.
Edward Stoner, Lynbrook, N. Y.

Water Works Superintendents

Ernest Frazier, Greenfield, Ind.
R. B. Carpenter, Missouri Valley, Ia.
William Boyle, Sac City, Ia.
Earl Warner, Sheldon, Ia.
Charles H. Smith, Winterset, Ia.
L. H. Beasley, Perry, Okla.

County Engineers

J. B. Hartley, Calhoun Co., Morgan, Ga.
Robert H. Horn, Darke Co., Greenville, Ohio.

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LARGE ANTI-FREEZING HYDRANTS 1¼" to 2" INCLUSIVE
LOCK-LID STREET WASHERS
ANTI-FREEZING COMPRESSION HYDRANT

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